FAKULTI KEJURUTERAAN

SET-SET SOALAN
KEJURUTERAAN SIVIL

25 OKTOBER 2004

UNIVERSITI MALAYSIA SARAWAK

94300 KOTA SAMARAHAN
SARAWAK

FAKULTI KEJURUTERAAN
(Faculty of Engineering)

Ekonomi Kejuruteraan
(Engineering Economy)

KNS 4343

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	12 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	9.00 am – 12.00 pm
Tempat *(Place)*	:	Bilik Seminar 23	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Prof. Madya Dr. FJ Putuhena			

Arahan *(Instruction)* :

1. **Jawab semua soalan.**
   (Answer all questions)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

Problem 1 (10 points)

You are about to borrow $ 3,000 from a bank at an interest rate of 9% compounded annually. You are required to make three equal annual repayments in the amount of $1,185.16 per year, with the first payment occurring at the end of year one. For each year, show the interest payment and principal payment.

Problem 2 (2.5 points each)

Consider the following two investment alternatives:

	Project's Cash Flow	
n	A	B
0	-$15,000	-$25,000
1	$9,500	$0
2	$12,500	$ X
3	$7,500	$ X
PW(15%)	?	$9,300

The firm's MARR is known to be 15%

(a) Compute the PW(15%) for project A
(b) Compute the unknown cash flow X in years two and three for project B
(c) Compute the project balance (at 15%) for project A at the end of year three
(d) Which project would you select?

Problem 3 (5 Points each)

The government is planning a hydroelectric project for a river basin. In addition to producing electric power, this project will provide flood control, irrigation, and recreational benefits. The estimated benefits and costs expected to be derived from the three alternatives under consideration are listed as follows:

	Decision Alternatives		
	A	B	C
Initial Cost	$8,000,000	$10,000,000	$15,000,000
Annual benefits:			
Power sales	$1,000,000	$1,200,000	$1,800,000
Flood control savings	$250,000	$350,000	$500,000
Irrigation benefits	$350,000	$450,000	$600,000
Recreation benefits	$100,000	$200,000	$350,000
O & M costs	$200,000	$250,000	$350,000

The interest rate is 10%, and the life of each project is estimated to be 50 years.

a. Find the benefit-cost ratio for each alternative
b. Select the best alternative, base on the incremental investment.

Problem 4 (5 Points each)

The double-declining-balance method is to be used for an asset with a cost of $80,000, estimated salvage value of $22,000, and estimated useful life of six years.

a. What is the depreciation for the first three tax years, assuming that the asset was placed in service at the beginning of the year?
b. If switching to the straight-line method is allowed, when is the optimal time to switch?

Problem 5 (5 Points each)

A business executive is trying to decide whether to undertake one of two contracts or neither one. He has simplified the situation somewhat and feels that it is sufficient to estimate that the contracts are specified as follows:

Contract A		Contract B	
PW	Probability	PW	Probability
$100,000	0.2	$40,000	0.3
$50,000	0.4	$10,000	0.4
$0	0.4	- $10,000	0.3

a. Should the executive undertake either one of the contracts? If so, which one? What would he choose if he were to make decisions by maximizing his expected PW?
b. What would be the probability that contract A would result in a larger profit than that of contract B?

TABLE 3-4 Discrete Compounding Interest Factors and Symbols[a]

To Find:	Given:	Factor by Which to Multiply "Given"[a]	Factor Name	Factor Functional Symbol[b]
For single cash flows:				
F	P	$(1+i)^N$	Single payment compound amount	$(F/P, i\%, N)$
P	F	$\frac{1}{(1+i)^N}$	Single payment present worth	$(P/F, i\%, N)$
For uniform series (annuities):				
F	A	$\frac{(1+i)^N - 1}{i}$	Uniform series compound amount	$(F/A, i\%, N)$
P	A	$\frac{(1+i)^N - 1}{i(1+i)^N}$	Uniform series present worth	$(P/A, i\%, N)$
A	F	$\frac{i}{(1+i)^N - 1}$	Sinking fund	$(A/F, i\%, N)$
A	P	$\frac{i(1+i)^N}{(1+i)^N - 1}$	Capital recovery	$(A/P, i\%, N)$

TABLE C-12 Discrete Compounding; $i = 9\%$

	Single Payment		Uniform Series				Uniform Gradient		
	Compound Amount Factor	Present Worth Factor	Compound Amount Factor	Present Worth Factor	Sinking Fund Factor	Capital Recovery Factor	Gradient Present Worth Factor	Gradient Uniform Series Factor	
	To Find *F* Given *P*	To Find *P* Given *F*	To Find *F* Given *A*	To Find *P* Given *A*	To Find *A* Given *F*	To Find *A* Given *P*	To Find *P* Given *G*	To Find *A* Given *G*	
N	*F/P*	*P/F*	*F/A*	*P/A*	*A/F*	*A/P*	*P/G*	*A/G*	*N*
1	1.0900	0.9174	1.0000	0.9174	1.0000	1.0900	0.000	0.0000	1
2	1.1881	0.8417	2.0900	1.7591	0.4785	0.5685	0.842	0.4785	2
3	1.2950	0.7722	3.2781	2.5313	0.3051	0.3951	2.386	0.9426	3
4	1.4116	0.7084	4.5731	3.2397	0.2187	0.3087	4.511	1.3925	4
5	1.5386	0.6499	5.9847	3.8897	0.1671	0.2571	7.111	1.8282	5
6	1.6771	0.5963	7.5233	4.4859	0.1329	0.2229	10.092	2.2498	6
7	1.8280	0.5470	9.2004	5.0330	0.1087	0.1987	13.375	2.6574	7
8	1.9926	0.5019	11.0285	5.5348	0.0907	0.1807	16.888	3.0512	8
9	2.1719	0.4604	13.0210	5.9952	0.0768	0.1668	20.571	3.4312	9
10	2.3674	0.4224	15.1929	6.4177	0.0658	0.1558	24.373	3.7978	10
11	2.5804	0.3875	17.5603	6.8052	0.0569	0.1469	28.248	4.1510	11
12	2.8127	0.3555	20.1407	7.1607	0.0497	0.1397	32.159	4.4910	12
13	3.0658	0.3262	22.9534	7.4869	0.0436	0.1336	36.073	4.8182	13
14	3.3417	0.2992	26.0192	7.7862	0.0384	0.1284	39.963	5.1326	14
15	3.6425	0.2745	29.3609	8.0607	0.0341	0.1241	43.807	5.4346	15
16	3.9703	0.2519	33.0034	8.3126	0.0303	0.1203	47.585	5.7245	16
17	4.3276	0.2311	36.9737	8.5436	0.0270	0.1170	51.282	6.0024	17
18	4.7171	0.2120	41.3013	8.7556	0.0242	0.1142	54.886	6.2687	18
19	5.1417	0.1945	46.0185	8.9501	0.0217	0.1117	58.387	6.5236	19
20	5.6044	0.1784	51.1601	9.1285	0.0195	0.1095	61.777	6.7674	20
21	6.1088	0.1637	56.7645	9.2922	0.0176	0.1076	65.051	7.0006	21
22	6.6586	0.1502	62.8733	9.4424	0.0159	0.1059	68.205	7.2232	22
23	7.2579	0.1378	69.5319	9.5802	0.0144	0.1044	71.236	7.4357	23
24	7.9111	0.1264	76.7898	9.7066	0.0130	0.1030	74.143	7.6384	24
25	8.6231	0.1160	84.7009	9.8226	0.0118	0.1018	76.927	7.8316	25
30	13.2677	0.0754	136.3075	10.2737	0.0073	0.0973	89.028	8.6657	30
35	20.4140	0.0490	215.7108	10.5668	0.0046	0.0946	98.359	9.3083	35
40	31.4094	0.0318	337.8824	10.7574	0.0030	0.0930	105.376	9.7957	40
45	48.3273	0.0207	525.8587	10.8812	0.0019	0.0919	110.556	10.1603	45
50	74.3575	0.0134	815.0836	10.9617	0.0012	0.0912	114.325	10.4295	50
60	176.0313	0.0057	1944.7921	11.0480	0.0005	0.0905	118.968	10.7683	60
80	986.5517	0.0010	10950.5741	11.0998	0.0001	0.0901	122.431	11.0299	80
100	5529.0408	0.0002	61422.6755	11.1091	*	0.0900	123.234	11.0930	100
∞				11.1111		0.0900			∞

* Less than 0.0001

TABLE C-13 Discrete Compounding; $i = 10\%$

	Single Payment		Uniform Series				Uniform Gradient	
	Compound Amount	Present	Compound	Present	Sinking	Capital	Gradient	Gradient

TABLE 6.1 Discrete Compounding i = 10%

	Single Payment		Uniform Series				Uniform Gradient		
	Compound Amount Factor	Present Worth Factor	Compound Amount Factor	Present Worth Factor	Sinking Fund Factor	Capital Recovery Factor	Gradient Present Worth Factor	Gradient Uniform Series Factor	
	To Find *F* Given *P*	To Find *P* Given *F*	To Find *F* Given *A*	To Find *P* Given *A*	To Find *A* Given *F*	To Find *A* Given *P*	To Find *P* Given *G*	To Find *A* Given *G*	
N	*F/P*	*P/F*	*F/A*	*P/A*	*A/F*	*A/P*	*P/G*	*A/G*	*N*
1	1.1000	0.9091	1.0000	0.9091	1.0000	1.1000	0.000	0.0000	1
2	1.2100	0.8264	2.1000	1.7355	0.4762	0.5762	0.826	0.4762	2
3	1.3310	0.7513	3.3100	2.4869	0.3021	0.4021	2.329	0.9366	3
4	1.4641	0.6830	4.6410	3.1699	0.2155	0.3155	4.378	1.3812	4
5	1.6105	0.6209	6.1051	3.7908	0.1638	0.2638	6.862	1.8101	5
6	1.7716	0.5645	7.7156	4.3553	0.1296	0.2296	9.684	2.2236	6
7	1.9487	0.5132	9.4872	4.8684	0.1054	0.2054	12.763	2.6216	7
8	2.1436	0.4665	11.4359	5.3349	0.0874	0.1874	16.029	3.0045	8
9	2.3579	0.4241	13.5795	5.7590	0.0736	0.1736	19.422	3.3724	9
10	2.5937	0.3855	15.9374	6.1446	0.0627	0.1627	22.891	3.7255	10
11	2.8531	0.3505	18.5312	6.4951	0.0540	0.1540	26.396	4.0641	11
12	3.1384	0.3186	21.3843	6.8137	0.0468	0.1468	29.901	4.3884	12
13	3.4523	0.2897	24.5227	7.1034	0.0408	0.1408	33.377	4.6988	13
14	3.7975	0.2633	27.9750	7.3667	0.0357	0.1357	36.801	4.9955	14
15	4.1772	0.2394	31.7725	7.6061	0.0315	0.1315	40.152	5.2789	15
16	4.5950	0.2176	35.9497	7.8237	0.0278	0.1278	43.416	5.5493	16
17	5.0545	0.1978	40.5447	8.0216	0.0247	0.1247	46.582	5.8071	17
18	5.5599	0.1799	45.5992	8.2014	0.0219	0.1219	49.640	6.0526	18
19	6.1159	0.1635	51.1591	8.3649	0.0195	0.1195	52.583	6.2861	19
20	6.7275	0.1486	57.2750	8.5136	0.0175	0.1175	55.407	6.5081	20
21	7.4002	0.1351	64.0025	8.6487	0.0156	0.1156	58.110	6.7189	21
22	8.1403	0.1228	71.4027	8.7715	0.0140	0.1140	60.689	6.9189	22
23	8.9543	0.1117	79.5430	8.8832	0.0126	0.1126	63.146	7.1085	23
24	9.8497	0.1015	88.4973	8.9847	0.0113	0.1113	65.481	7.2881	24
25	10.8347	0.0923	98.3471	9.0770	0.0102	0.1102	67.696	7.4580	25
30	17.4494	0.0573	164.4940	9.4269	0.0061	0.1061	77.077	8.1762	30
35	28.1024	0.0356	271.0244	9.6442	0.0037	0.1037	83.987	8.7086	35
40	45.2593	0.0221	442.5926	9.7791	0.0023	0.1023	88.953	9.0962	40
45	72.8905	0.0137	718.9048	9.8628	0.0014	0.1014	92.454	9.3740	45
50	117.3909	0.0085	1163.9085	9.9148	0.0009	0.1009	94.889	9.5704	50
60	304.4816	0.0033	3034.8164	9.9672	0.0003	0.1003	97.701	9.8023	60
80	2048.4002	0.0005	20474.0021	9.9951	*	0.1000	99.561	9.9609	80
100	13780.6123	0.0001	137796.1234	9.9993	*	0.1000	99.920	9.9927	100
∞				10.0000		0.1000			∞

* Less than 0.0001

8.3333 0.1200

* Less than 0.0001

17% Discrete Compounding

	Single Payment		Uniform Series				Uniform Gradient		
	Compound Amount Factor	Present Worth Factor	Compound Amount Factor	Present Worth Factor	Sinking Fund Factor	Capital Recovery Factor	Gradient Present Worth Factor	Gradient Uniform Series Factor	
	To Find *F* Given *P*	To Find *P* Given *F*	To Find *F* Given *A*	To Find *P* Given *A*	To Find *A* Given *F*	To Find *A* Given *P*	To Find *P* Given *G*	To Find *A* Given *G*	
N	*F P*	*P F*	*F A*	*P A*	*A F*	*A P*	*P G*	*A G*	*N*
1	1.1500	0.8696	1.0000	0.8696	1.0000	1.1500	0.000	0.0000	1
2	1.3225	0.7561	2.1500	1.6257	0.4651	0.6151	0.756	0.4651	2
3	1.5209	0.6575	3.4725	2.2832	0.2880	0.4380	2.071	0.9071	3
4	1.7490	0.5718	4.9934	2.8550	0.2003	0.3503	3.786	1.3263	4
5	2.0114	0.4972	6.7424	3.3522	0.1483	0.2983	5.775	1.7228	5
6	2.3131	0.4323	8.7537	3.7845	0.1142	0.2642	7.937	2.0972	6
7	2.6600	0.3759	11.0668	4.1604	0.0904	0.2404	10.192	2.4498	7
8	3.0590	0.3269	13.7268	4.4873	0.0729	0.2229	12.481	2.7813	8
9	3.5179	0.2843	16.7858	4.7716	0.0596	0.2096	14.755	3.0922	9
10	4.0456	0.2472	20.3037	5.0188	0.0493	0.1993	16.980	3.3832	10
11	4.6524	0.2149	24.3493	5.2337	0.0411	0.1911	19.129	3.6549	11
12	5.3503	0.1869	29.0017	5.4206	0.0345	0.1845	21.185	3.9082	12
13	6.1528	0.1625	34.3519	5.5831	0.0291	0.1791	23.135	4.1438	13
14	7.0757	0.1413	40.5047	5.7245	0.0247	0.1747	24.973	4.3624	14
15	8.1371	0.1229	47.5804	5.8474	0.0210	0.1710	26.693	4.5650	15
16	9.3576	0.1069	55.7175	5.9542	0.0179	0.1679	28.296	4.7522	16
17	10.7613	0.0929	65.0751	6.0472	0.0154	0.1654	29.783	4.9251	17
18	12.3755	0.0808	75.8364	6.1280	0.0132	0.1632	31.157	5.0843	18
19	14.2318	0.0703	88.2118	6.1982	0.0113	0.1613	32.421	5.2307	19
20	16.3665	0.0611	102.4436	6.2593	0.0098	0.1598	33.582	5.3651	20
21	18.8215	0.0531	118.8101	6.3125	0.0084	0.1584	34.645	5.4883	21
22	21.6447	0.0462	137.6316	6.3587	0.0073	0.1573	35.615	5.6010	22
23	24.8915	0.0402	159.2764	6.3988	0.0063	0.1563	36.499	5.7040	23
24	28.6252	0.0349	184.1678	6.4338	0.0054	0.1554	37.302	5.7979	24
25	32.9190	0.0304	212.7930	6.4641	0.0047	0.1547	38.031	5.8834	25
30	66.2118	0.0151	434.7451	6.5660	0.0023	0.1523	40.753	6.2066	30
35	133.1755	0.0075	881.1702	6.6166	0.0011	0.1511	42.359	6.4019	35
40	267.8635	0.0037	1779.0903	6.6418	0.0006	0.1506	43.283	6.5168	40
45	538.7693	0.0019	3585.1285	6.6543	0.0003	0.1503	43.805	6.5830	45
50	1083.6574	0.0009	7217.7163	6.6605	0.0001	0.1501	44.096	6.6205	50
60	4383.9987	0.0002	29219.9916	6.6651	*	0.1500	44.343	6.6530	60
80	71750.8794	*	478332.5293	6.6666	*	0.1500	44.436	6.6656	80
100	1174313.4507	*	7828749.6713	6.6667	*	0.1500	44.444	6.6666	100
∞				6.6667		0.1500			∞

* Less than 0.0001

UNIVERSITI MALAYSIA SARAWAK

94300 KOTA SAMARAHAN
SARAWAK

FAKULTI KEJURUTERAAN

(Faculty of Engineering)

Teori Struktur

(Theory of Structures)

KNS 2093

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	6hb September 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	9.00 – 11.00 am
Tempat *(Place)*	:	BS 6	**Jangkamasa** *(Duration)*	:	2 jam
Pensyarah *(Lecturer)*	:	Miss Adeline Ng Ling Ying			

Arahan *(Instruction)* :

1. **Jawab dua soalan sahaja.**
   (Answer two questions only)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

Question 1 (25 marks)

Determine the moments at the ends of each member in Figure 1 by using the Moment Distribution Method. Draw the moment diagram for each member. EI is constant and all joints are fixed-connected.

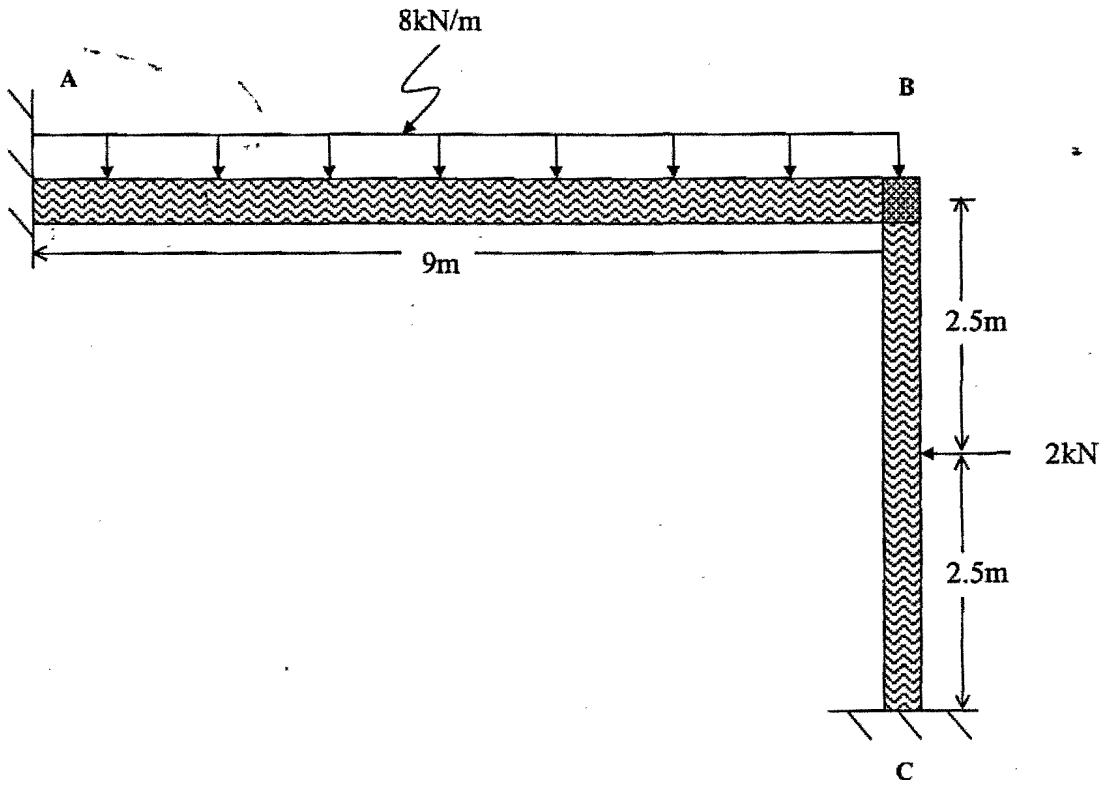
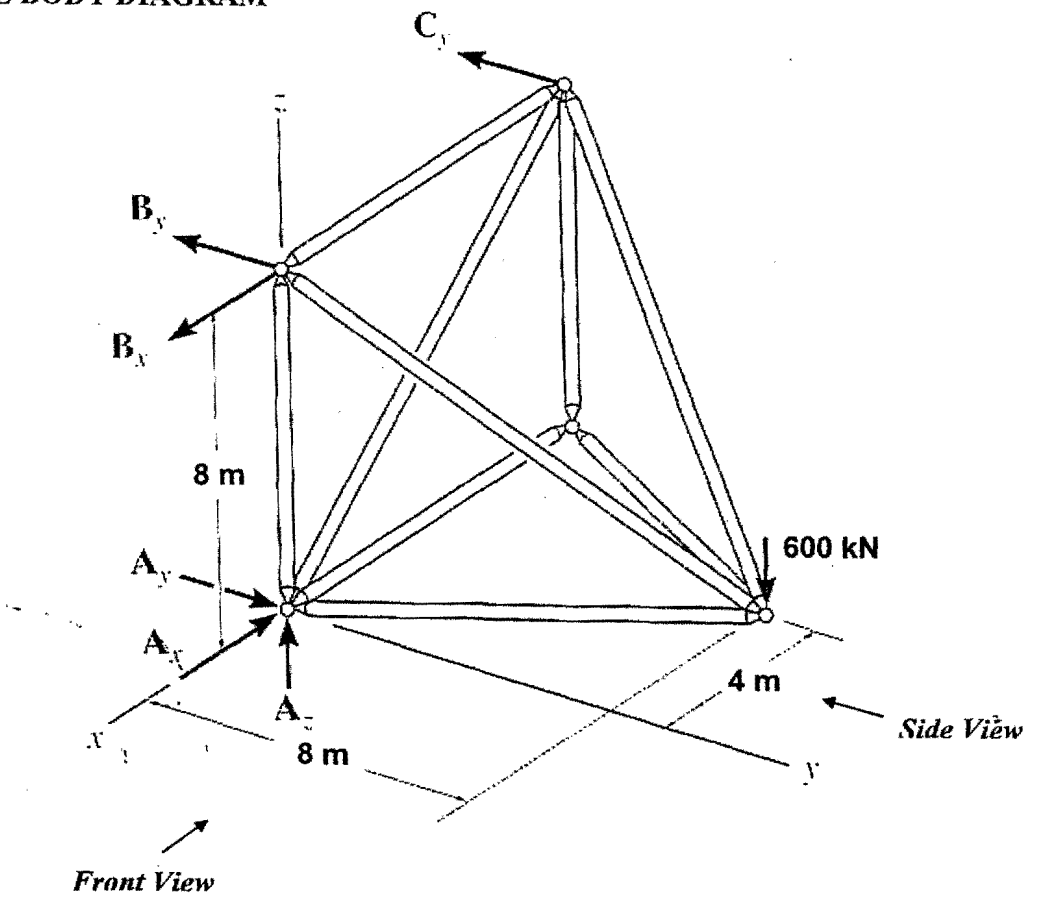
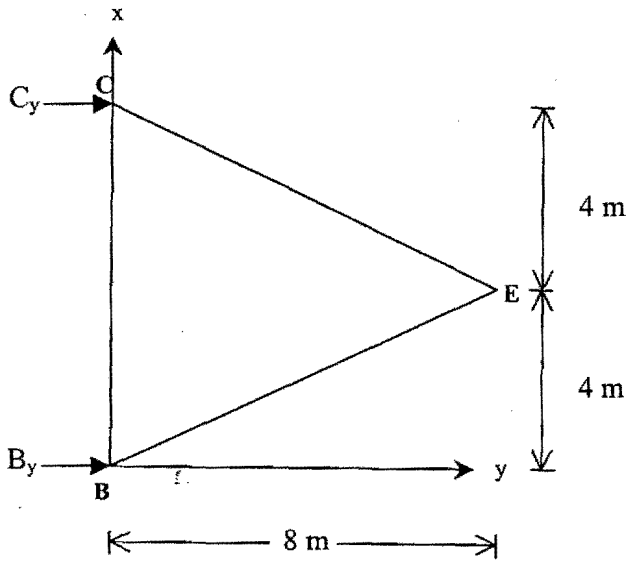


Figure 1

FREE BODY DIAGRAM



PLAN VIEW



COORDINATES:

A	(0, 0, 0)
B	(0, 0, 8)
C	(-8, 0, 8)
D	(-8, 0, 0)
E	(-4, 8, 0)

Joint B

Members	lx	ly	lz	L	t	T = t x L	C or T
BA							
BC							
BE							
External Force							

Joint A

Members	lx	ly	lz	L	t	T = t x L	C or T
AB							
AC							
AD							
AE							
External Force							

Joint D

Members	lx	ly	lz	L	t	T = t x L	C or T
DA							
DC							
DE							
External Force							

Joint C

Members	lx	ly	lz	L	t	T = t x L	C or T
CA							
CB							
CD							
CE							
External Force							

Question 3 **(25 marks)**

Determine the slope and vertical deflection at point B on the beam as shown in Figure 3 by using both the method of virtual work and conjugate beam method. Assume A is a fixed support and EI is constant.

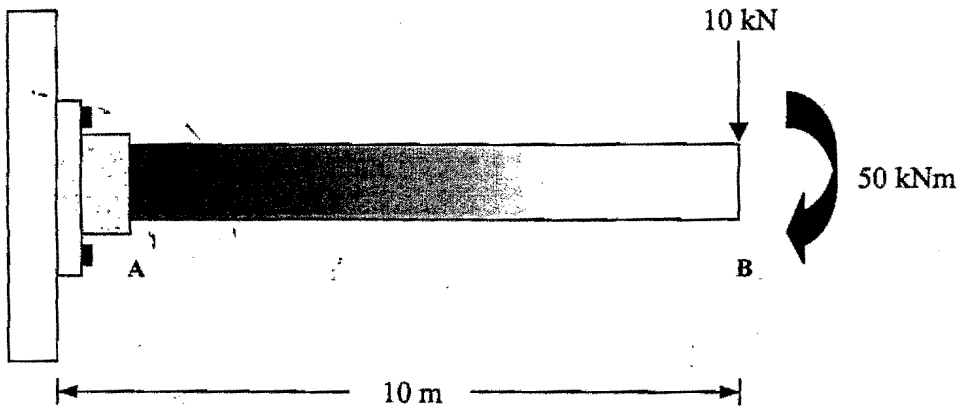


Figure 3

Question 4 (25 marks)

Assume the support at A is fixed. Draw the influence lines for:

(a) The vertical reaction at A.

(b) The moment at A.

(c) The shear at B.

(d) The moment at B.

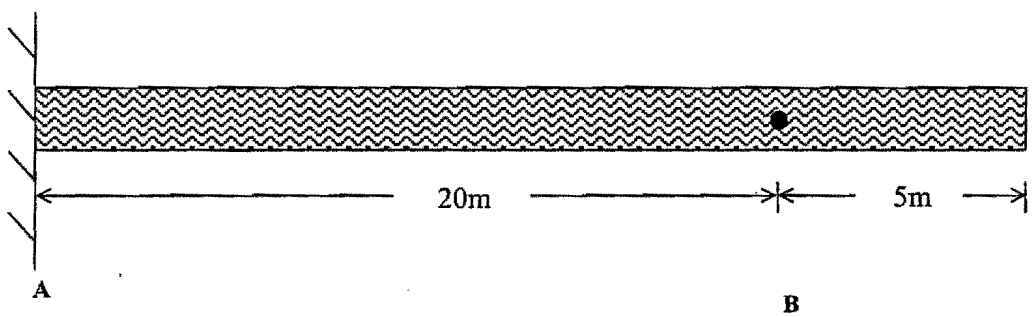
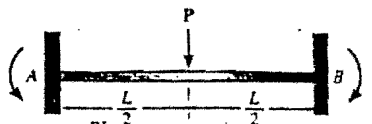
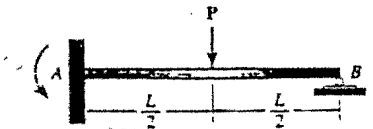


Figure 4

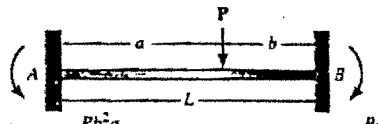
Fixed End Moments



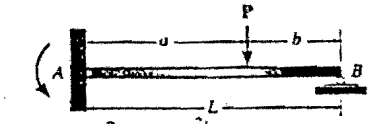
$(FEM)_{AB} = \frac{PL}{8}$ $(FEM)_{BA} = \frac{PL}{8}$



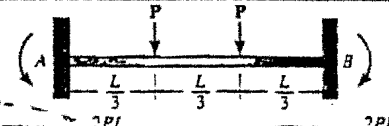
$(FEM)'_{AB} = \frac{3PL}{16}$



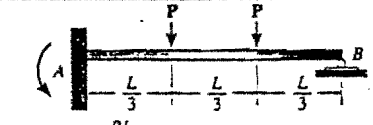
$(FEM)_{AB} = \frac{Pb^2a}{L^2}$ $(FEM)_{BA} = \frac{Pa^2b}{L^2}$



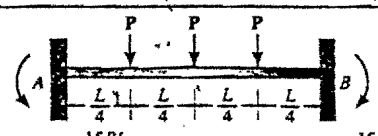
$(FEM)'_{AB} = \left(\frac{P}{L^2}\right)\left(b^2a + \frac{a^2b}{2}\right)$



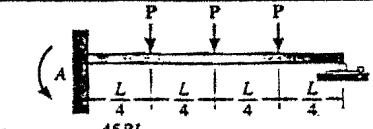
$(FEM)_{AB} = \frac{2PL}{9}$ $(FEM)_{BA} = \frac{2PL}{9}$



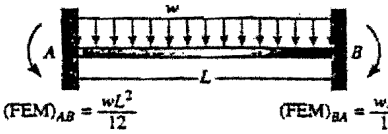
$(FEM)'_{AB} = \frac{PL}{3}$



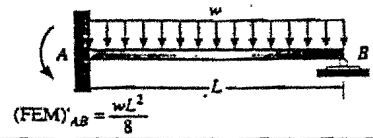
$(FEM)_{AB} = \frac{15PL}{48}$ $(FEM)_{BA} = \frac{15PL}{48}$



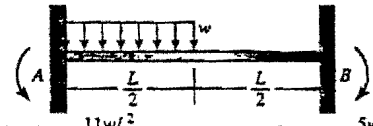
$(FEM)'_{AB} = \frac{45PL}{96}$



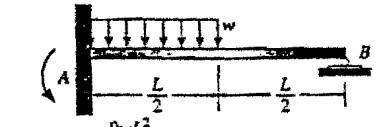
$(FEM)_{AB} = \frac{wL^2}{12}$ $(FEM)_{BA} = \frac{wL^2}{12}$



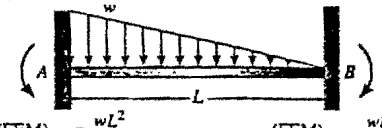
$(FEM)'_{AB} = \frac{wL^2}{8}$



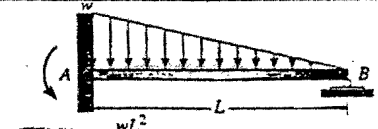
$(FEM)_{AB} = \frac{11wL^2}{192}$ $(FEM)_{BA} = \frac{5wL^2}{192}$



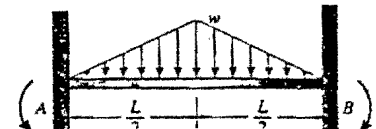
$(FEM)'_{AB} = \frac{9wL^2}{128}$



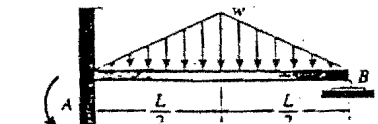
$(FEM)_{AB} = \frac{wL^2}{20}$ $(FEM)_{BA} = \frac{wL^2}{30}$



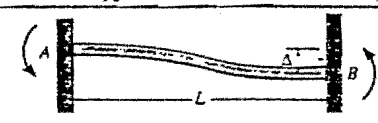
$(FEM)'_{AB} = \frac{wL^2}{15}$



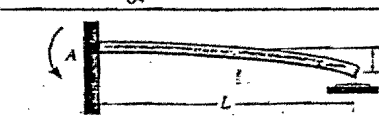
$(FEM)_{AB} = \frac{5wL^2}{96}$ $(FEM)_{BA} = \frac{5wL^2}{96}$



$(FEM)'_{AB} = \frac{5wL^2}{64}$



$(FEM)_{AB} = \frac{6EI\Delta}{L^2}$ $(FEM)_{BA} = \frac{6EI\Delta}{L^2}$



$(FEM)'_{AB} = \frac{3EI\Delta}{L^2}$

UNIVERSITI MALAYSIA SARAWAK

94300 KOTA SAMARAHAN
SARAWAK

FAKULTI KEJURUTERAAN

(Faculty of Engineering)

Geologi Kejuruteraan

(Engineering Geology)

KNS 2102

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	15 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	9.00 am– 12.00 pm
Tempat *(Place)*	:	Bilik Seminar 23	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Dr. Azhaili Baharun			

Arahan *(Instruction)* :

1. **Jawab hanya 5 soa;an yang mendatangkan markah keseluruhan 100%.**
   (Answer only 5 questions that will add up the total marks to 100%)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

Question 1

a) What are magma, lava, extrusive and intrusive rocks? **[12 marks]**

b) List five sources of heat for melting in the crust. **[10 marks]**

Question 2

a) What are weathering processes? **[3 marks]**

b) What is mass wasting? **[5 marks]**

c) Give explanations on 4 types of mass wasting. **[12 marks]**

Question 3

a) What is the difference between granite and rock salt? **[4 marks]**

b) What are the five conditions in a geologic sense a substance must satisfy to be classified as a mineral? Explain also the characteristic physical properties it must possess. **[16 marks]**

Question 4

Boreholes are holes, normally vertical, drilled into the ground to obtain subsurface samples. List down and explain the methods used for boring into:

1. soils
2. rocks

[20 marks]

Question 5

a) Groundwater is 14% of freshwater in hydrosphere. What is the average rate of groundwater exchange and what does it mean by 'exchange'. **[4 marks]**

b) What is uniformitariasm according to geologist? **[2 marks]**

c) Give 4 samples of Nonmarine Sedimentary Environments. **[12 marks]**

Question 6

Please draw or sketch

a) Folds of 1. Recumbent, 2. Upright, 3. Isoclinal, 4. Anticlines, 5. Synclines 6. Monoclines
b) Faults of 1. Thrust and Reverse, 2. Normal, 3. Strike-slip, 4. Horst and Graben

[20 marks]

UNIVERSITI MALAYSIA SARAWAK

94300 KOTA SAMARAHAN
SARAWAK

FAKULTI KEJURUTERAAN

(Faculty of Engineering)

Struktur Hidraulik

(Hydraulic Structures)

KNS 4393

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	14 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	2.00 pm– 5.00 pm
Tempat *(Place)*	:	Dewan Kuliah I	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Prof. Madya Dr. Nabil Bessaih			

Arahan *(Instruction)* :

1. **Jawab semua soalan.**
   (Answer all questions)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

Question 1 (10 marks)

a- What are the advantages of an earthfill dam relatively to a concrete dam?
b- What are the different parameters will you be considering during the selection of the dam type?
c- Sketch different methods for underseepage control in case of an earthfill dam.
d- Why is it necessary to aerate the flow in a siphon spillway?
e- What is advantage of a labyrinth spillway relatively to an overflow spillway?
f- What is the main advantage of Basin II relatively to Basin I?
g- In which case will you consider the use of Basin IV for energy dissipation?
h- If the Froude number is higher than 10 which kind of energy dissipator will you be considering?

Question 2 (20 marks)

An overflow spillway has a vertical upstream face and a crest length of 240 ft. The upstream water surface at design discharge is at EL 970 ft and the average channel floor is at EL 870. The Design Discharge is 75 000 cfs

1. Determine the crest elevation and the shape of the overfow spillway
2. Determine the pressure on the crest of the spillway for operating head equal 1.33 times the design head. Assume no piers
3. Compute the upper nappe profile assuming no piers. For design head
4. If the tailwater elevation is at EL 930ft. Proportion a USBR basin II .

Question 3 (20 marks)

The profile of a concrete dam is shown in Figure 1. Check the stability giants overturning and sliding of the dam for NLC.

γ_w: 10 kN/m^3
γ_c: 24 kN/m^3
c=600 kN m^{-2}
ϕ_c= 35°
γ_s': 15 kN/m^3
ϕ_s= 35°

If the dam is not stable against overturning, sketch a proposed solution for this.

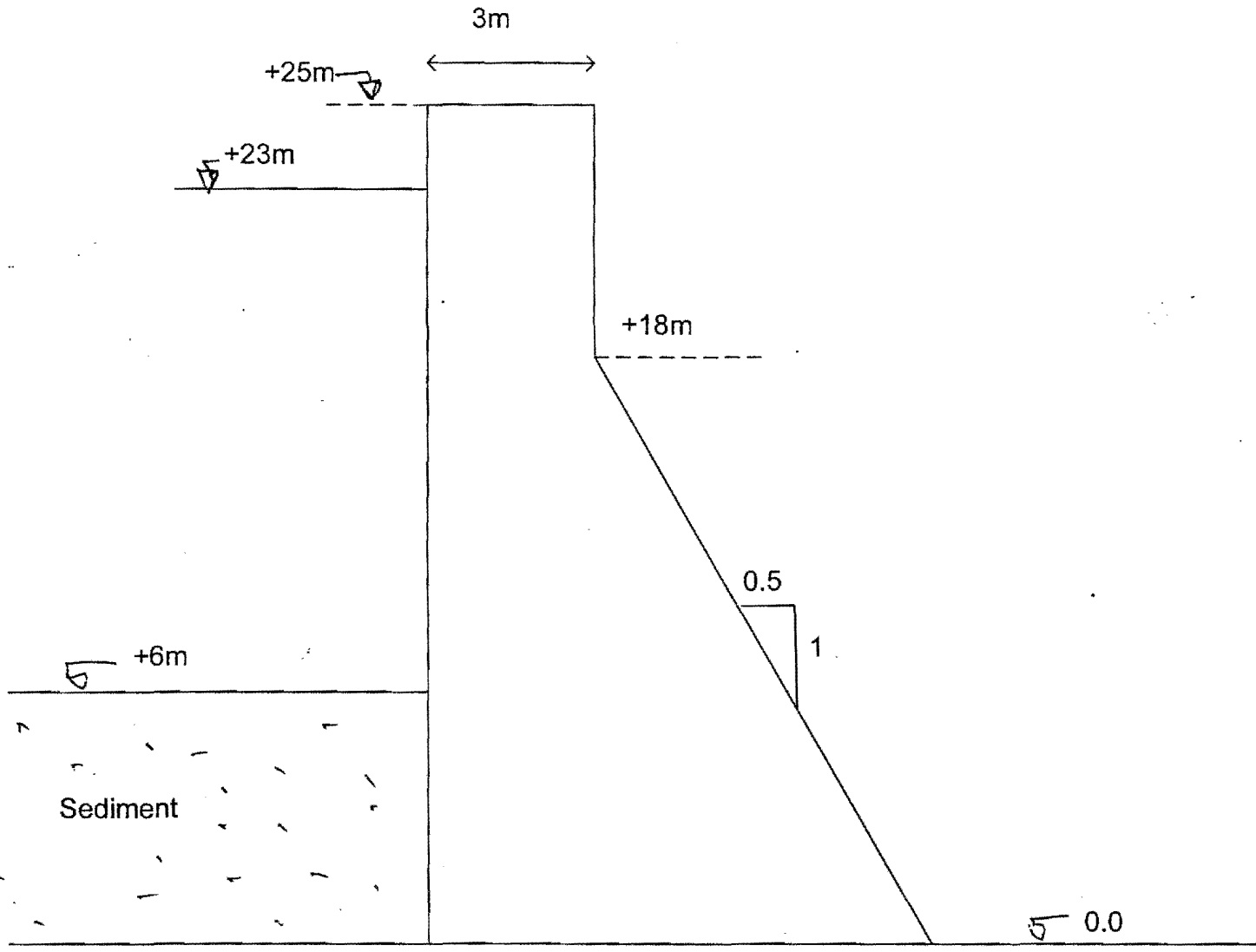


Figure 1

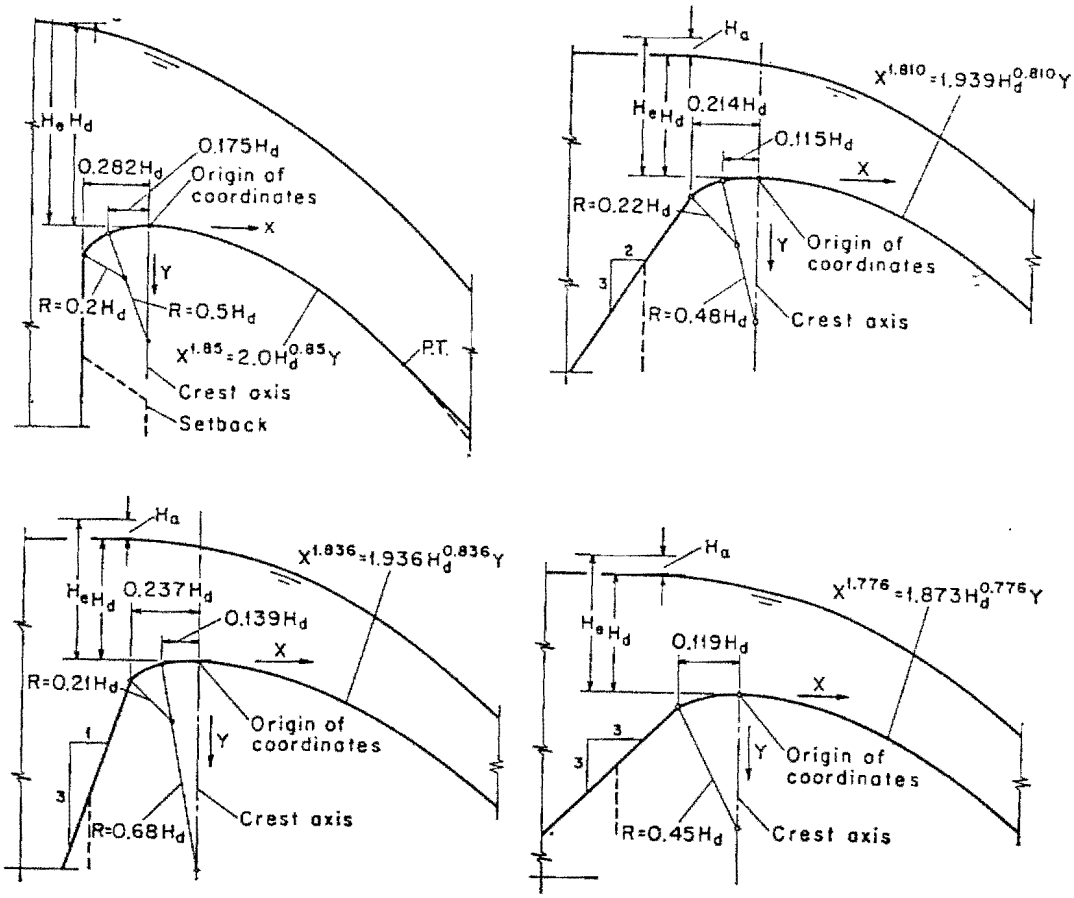


FIG. 14-3. The WES-standard spillway shapes. (*U.S. Army Engineers Waterways Experiment Station.*)

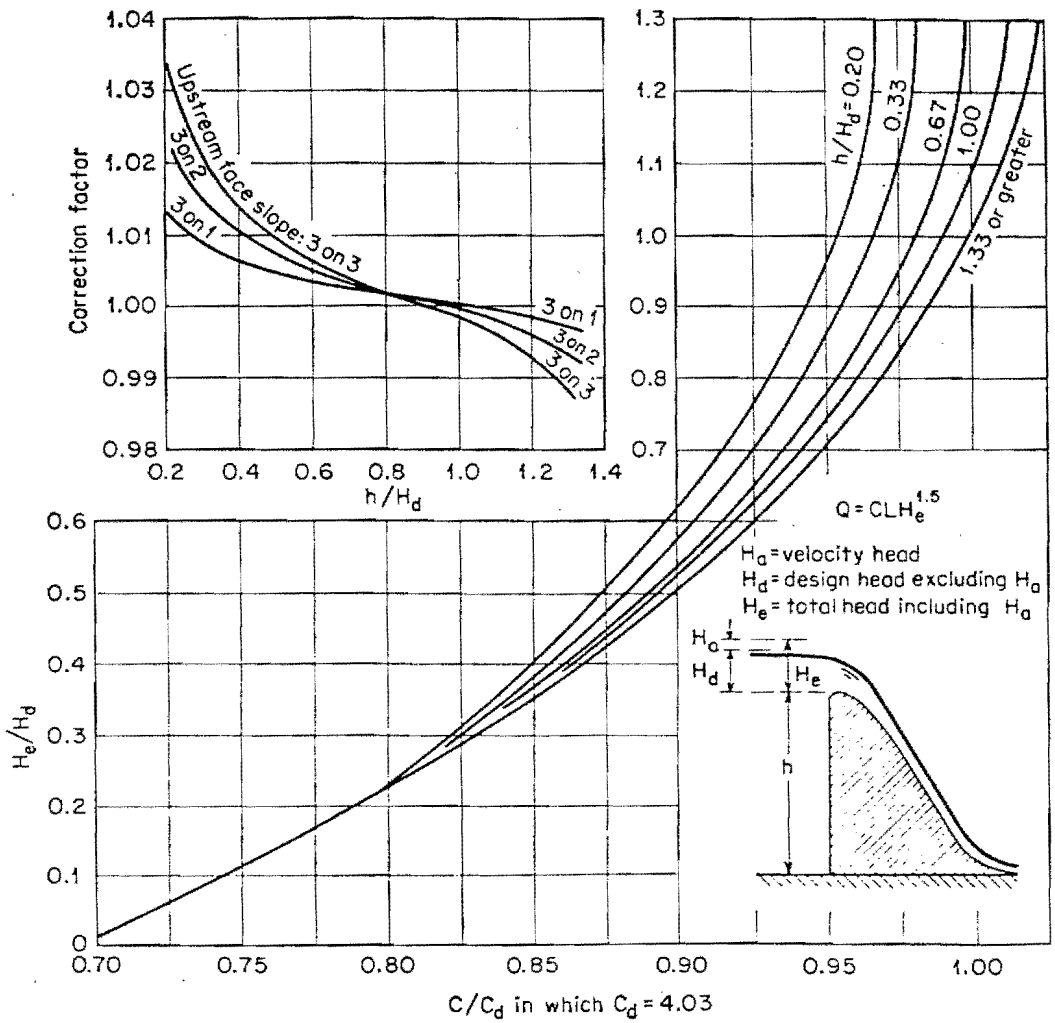
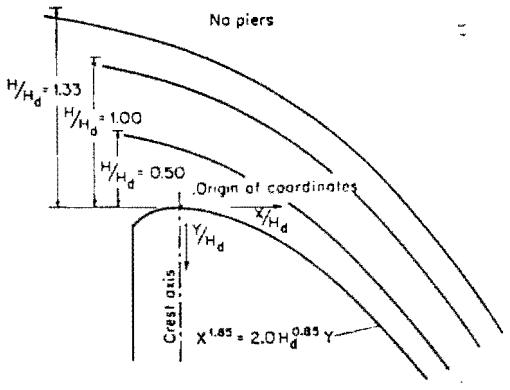


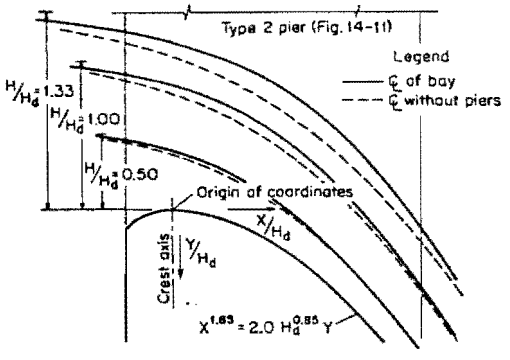
FIG. 14-4. Head-discharge relation for WES-standard spillway shapes.



COORDINATES FOR UPPER NAPPE WITH NO PIERS*

$H/H_d = 0.50$		$H/H_d = 1.00$		$H/H_d = 1.33$	
X/H_d	Y/H_d	X/H_d	Y/H_d	X/H_d	Y/H_d
−1.0	−0.490	−1.0	−0.933	−1.0	−1.210
−0.8	−0.484	−0.8	−0.915	−0.8	−1.185
−0.6	−0.475	−0.6	−0.893	−0.6	−1.151
−0.4	−0.460	−0.4	−0.865	−0.4	−1.110
−0.2	−0.425	−0.2	−0.821	−0.2	−1.060
0.0	−0.371	0.0	−0.755	0.0	−1.000
0.2	−0.300	0.2	−0.681	0.2	−0.919
0.4	−0.200	0.4	−0.586	0.4	−0.821
0.6	−0.075	0.6	−0.465	0.6	−0.705
0.8	0.075	0.8	−0.320	0.8	−0.569
1.0	0.258	1.0	−0.145	1.0	−0.411
1.2	0.470	1.2	0.055	1.2	−0.220
1.4	0.705	1.4	0.294	1.4	−0.002
1.6	0.972	1.6	0.563	1.6	0.243
1.8	1.269	1.8	0.857	1.8	0.531

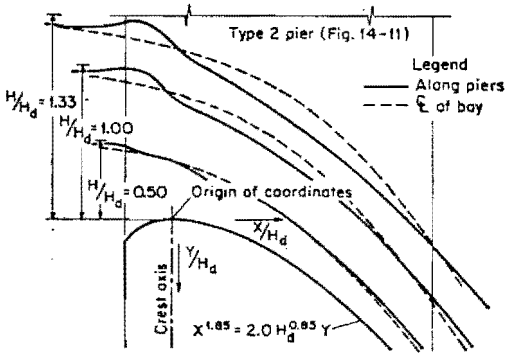
* Based on CW 801 tests for negligible velocity of approach.



COORDINATES FOR UPPER NAPPE AT CENTER LINE OF BAY WITH TYPE 2 PIERS*

$H/H_d = 0.50$		$H/H_d = 1.00$		$H/H_d = 1.33$	
X/H_d	Y/H_d	X/H_d	Y/H_d	X/H_d	Y/H_d
−1.0	−0.482	−1.0	−0.941	−1.0	−1.230
−0.8	−0.480	−0.8	−0.932	−0.8	−1.215
−0.6	−0.472	−0.6	−0.913	−0.6	−1.194
−0.4	−0.457	−0.4	−0.890	−0.4	−1.165
−0.2	−0.431	−0.2	−0.855	−0.2	−1.122
0.0	−0.384	0.0	−0.805	0.0	−1.071
0.2	−0.313	0.2	−0.735	0.2	−1.015
0.4	−0.220	0.4	−0.647	0.4	−0.944
0.6	−0.088	0.6	−0.539	0.6	−0.847
0.8	0.075	0.8	−0.389	0.8	−0.725
1.0	0.257	1.0	−0.202	1.0	−0.564
1.2	0.462	1.2	0.015	1.2	−0.356
1.4	0.705	1.4	0.266	1.4	−0.102
1.6	0.977	1.6	0.521	1.6	0.172
1.8	1.278	1.8	0.860	1.8	0.465

* Based on CW 801 tests for negligible velocity of approach.



COORDINATES FOR UPPER NAPPE ALONG PIERS*

$H/H_d = 0.50$		$H/H_d = 1.00$		$H/H_d = 1.33$	
X/H_d	Y/H_d	X/H_d	Y/H_d	X/H_d	Y/H_d
−1.0	−0.495	−1.0	−0.950	−1.0	−1.253
−0.8	−0.492	−0.8	−0.940	−0.8	−1.221
−0.6	−0.490	−0.6	−0.929	−0.6	−1 209
−0.4	−0.482	−0.4	−0.930	−0.4	−1.218
−0.2	−0.440	−0.2	−0.925	−0.2	−1.244
0.0	−0.383	0.0	−0.779	0.0	−1.103
0.2	−0.265	0.2	−0.651	0.2	−0.950
0.4	−0.185	0.4	−0.545	0.4	−0.821
0.6	−0.076	0.6	−0.425	0.6	−0.689
0.8	0.060	0.8	−0.285	0.8	−0.549
1.0	0.240	1.0	−0.121	1.0	−0.389
1.2	0.445	1.2	0.067	1.2	−0.215
1.4	0.675	1.4	0.286	1.4	0.011
1.6	0.925	1.6	0.521	1.6	0.208
1.8	1.177	1.8	0.779	1.8	0.438

* Based on CW 801 tests for negligible velocity of approach.

FIG. 14-8. Upper nappe profiles of flow over WES spillways with and without piers. (*U.S. Army Engineers Waterways Experiment Station.*)

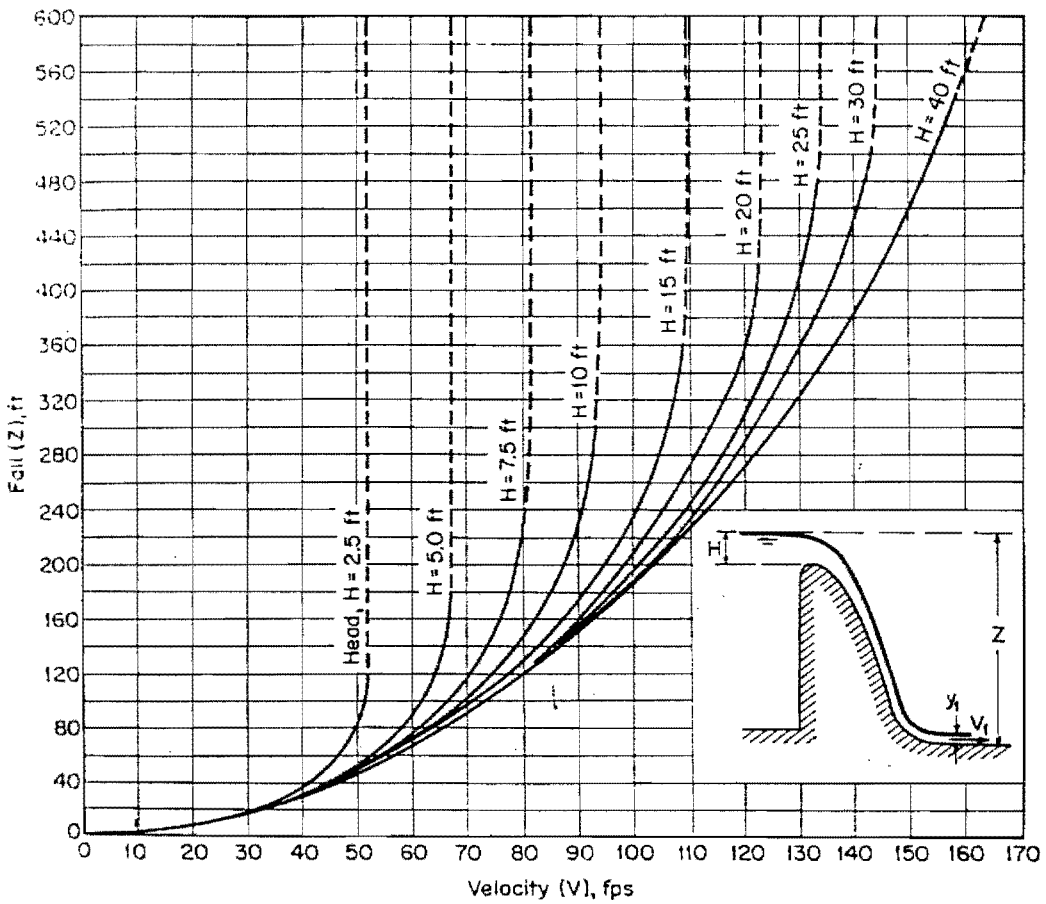


FIG. 14-15. Curves for determination of velocity at the toe of spillways with slopes 1 on 0.6 to 0.8.

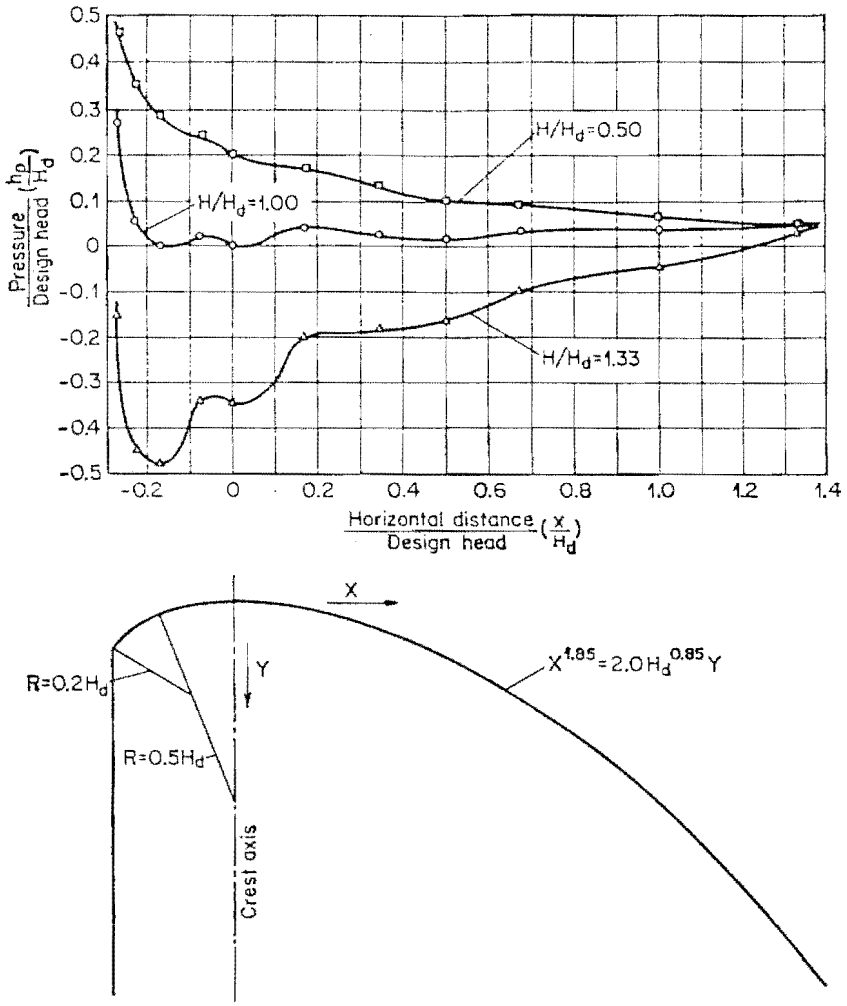


FIG. 14-13. Crest pressures on WES high overflow spillways. (*a*) No piers. (*U.S. Army Engineers Waterways Experiment Station* [20], *Hydraulic Design Chart* 111-16, *WES* 9-54.)

$$F = \frac{V}{\sqrt{g y}}$$

$$F_s = K_a \gamma_s' \frac{h_s^2}{2}$$

$$K_a = \frac{1 - \sin \phi_s}{1 + \sin \phi_s}$$

$$F_{sF} = \frac{c\, An + \Sigma V \tan \phi}{\Sigma H}$$

UNIVERSITI MALAYSIA SARAWAK

94300 KOTA SAMARAHAN
SARAWAK

FAKULTI KEJURUTERAAN

(Faculty of Engineering)

Praktis Kejuruteraan Sivil

(Civil Engineering Practice)

KNS 1032

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	14 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	9.00 – 11.00 am
Tempat *(Place)*	:	BS 23	**Jangkamasa** *(Duration)*	:	2 jam
Pensyarah *(Lecturer)*	:	Dr. Siti Halipah Ibrahim			

Arahan *(Instruction)* :

1. **Jawab semua soalan**
   (Answer all questions)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

Question 1

a. Name 4 types of sectors involved in construction. **[8 marks]**

b. What is the role of civil engineer during the construction stage? **[12 marks]**

Question 2

a. What is the purpose of site investigation. **[2 marks]**

b. Give 3 stages to carrying out site investigation procedures. **[6 marks]**

c. Explain into details 3 stages stated above. **[12 marks]**

Question 3

a. Name 4 types of mechanical plant used for construction. **[8 marks]**

b. Choose 3 types of the plants and explain the function of the machinery.

[12marks]

Question 4

a. What is a contract document? **[5 marks]**

b. Name 3 types of contract. **[6 marks]**

c. Explain into details the types of contract stated above. **[9 marks]**

Question 5

" I think we put too much responsibility on the shoulders of management when it comes to maintaining safe job sites," said one student of safety of health. After all, you can't make an employee work safely. If an employee fails to follow the rules and gets hurt, that his problem." It's true that you can't make an employee work safely, but management should still be responsible for establishing, implementing and enforcing a safety program," responded another student.

Discuss about the matter above and give the reason to support the statement.

[20 marks]

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FAKULTI KEJURUTERAAN
(Faculty of Engineering)

Mekanik Bendalir
(Fluid Mechanics)

KNS 2113

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	13 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	2.00 pm– 5.00 pm
Tempat *(Place)*	:	Bilik Seminar 11	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Prof. Salim Said			

Arahan *(Instruction)* :

1. **Jawab semua soalan.**
   (Answer all questions)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

1. Water is supplied to a three-storey building through a buried pipeline. Assume that the pipeline is at the same elevation as the floor of the first storey of the building. The height of each storey is 3.5 m. A showerhead is connected to the piping system 2 m above the floor of each storey. The maximum velocity of flow from the showerhead of the second floor is 9 m/s. For steady inviscid flow, determine the maximum velocity from the showerheads of the first and third storey. **[20 marks]**

2. A sluice gate across a channel is opened to such a height that the flow depth immediately after the gate is 0.5 m. The depth of flow upstream (behind) to the gate is 5 m, which is much deeper than the flow depth after the gate. The width of the channel is 2 m. Determine the horizontal reaction force R_x required to hold the gate in place, if the velocity of flow downstream to gate is 12 m/s. Assume that the frictional force F_f (between the channel bottom and the flowing water) is $0.1R_x$ **[20 marks]**

3. A vertical partition is erected in an open tank (Fig. 1). A rectangular gate which is 4 m high and 2 m wide and hinged at the lower end is located in the partition. The tank consists of, on one side of the partition, gasoline with a density $\rho = 700$ kg/m^3 at a depth of 4 m. On the other side of the tank, water is slowly added. At what depth, h, will the gate start to open? **[20 marks]**

4. At a sudden contraction in a pipe the diameter changes from D_1 to D_2. The pressure drop, Δp, which develops across the contraction is a function of D_1 and D_2, as well as the velocity of the larger pipe, V, the fluid density, ρ, and the viscosity, μ. Use D_1, V, and μ as repeating variables to determine a suitable set of dimensionless parameters. **[20 marks]**

5. The gate shown in Fig. 2 is hinged at H. The gate is 1.6 m wide normal to the plane of the diagram. (a) Calculate the resultant force due to the water pressure on the gate (b) Find the centre of pressure, and (c) Calculate the force required at A to hold the gate closed. **[20 marks]**

Note: For question no. 5, geometric properties of the gate are:

a = length of gate
b = width of gate
A = ba
$I_{xc} = (1/12)ba^3$
$I_{yc} = (1/12)ab^3$
$I_{xyc} = 0$

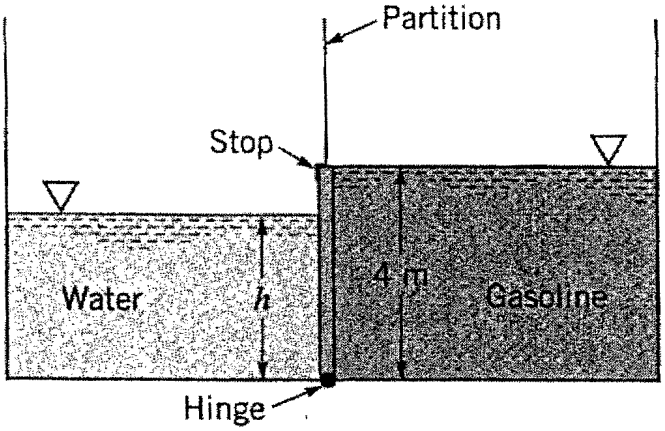

Fig. 1

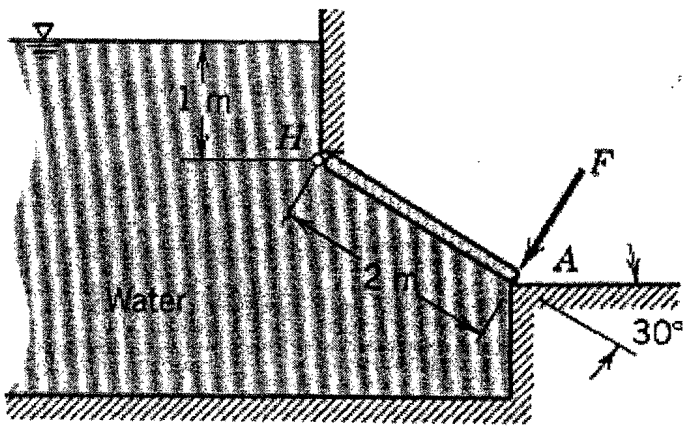

Fig. 2

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FAKULTI KEJURUTERAAN
(Faculty of Engineering)

Lukisan Kejuruteraan
(Engineering Drawings)

KNS 1022

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	22 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	9.00 am – 11.00 am
Tempat *(Place)*	:	Bilik Seminar 23	**Jangkamasa** *(Duration)*	:	2 jam
Pensyarah *(Lecturer)*	:	Cik Ting Sim Nee			

Arahan *(Instruction)* :

1. **Jawab semua soalan.**
   (Answer all questions)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

Question 1:

Name the following lines and their application accordingly:

a) ——————————

b) —·—·—·—·—·—·—·—·—·—·—

c) — — — — — — —

What are the lettering sizes for the following?

a) Main Headings
b) Sub-headings

Name two (2) lettering dos or don'ts in proper lettering technique.

Name three (3) dimensioning do or don'ts.

[15 marks]

Question 2:

Using proper drawing construction technique, draw a circle and describe your procedures. The diameter of the circle is 25 mm.
Note: Do not erase any lines you have done.

Indicate also the dimensions and define the terms you have used for your dimensioning.

[20 marks]

Question 3:

Draw the symbols for the following items in:

a) Civil Drawing:

- Pillar hydrant
- Sluice Valve
- Manhole
- Concrete footpath
- Verge
- Culverts

[12 marks]

b) Architectural Drawings

- Sink
- Bath
- Cavity Sliding doors
- Louver windows

[8 marks]

c) Structural Drawing: Reinforced Concrete Design

- Column Cross Section with size 250mm X 250mm and REO of 4Y20 and Stirrups of R8 ~ 300mm

[5 marks]

d) Structural Drawing: Steel Design

- Butt Weld
- Fillet Weld

[5marks]

30

Question 4:

a) Describe briefly perimeter drains, monsoon drains and culverts.

[6 marks]

b) What are the procedures of detailing roadwork and what is the arrangement of roads, footpaths, verge and drain in roadwork drawings?

14 14 marks.

[12 marks]

18

Question 5:

a) In Reinforced Concrete Design what do the following terms stand for?
i) 2Y16
ii) R6 – 150mm

[5 marks]

b) For beam detailing, how many views would a detailer generally draw? Describe each view with what each view is trying to indicate.

[10 marks]

15

Question 6:

a) What shape does a universal column (UC) have?

[2 marks]

b) There are few types of connections available in steel works. Describe bolting in detail.

[6 marks]

c) When connecting a UC to a footing with bolts and fillet welding, what is the essential **item** that forms part of the bolting work? Sketch the connection details from the side view.

[12 marks]

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94300 KOTA SAMARAHAN
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FAKULTI KEJURUTERAAN

(Faculty of Engineering)

Rekabentuk Struktur Keluli

(Structural Steel Design)

KNS 4214

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	21 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	9.00 am – 12.00 pm
Tempat *(Place)*	:	Dewan Kuliah I	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Pn. Azida Rashidi			

Arahan *(Instruction)* :

1. **Seksyen A adalah wajib. Kemudian pilih dan jawab samada Seksyen B atau C.**
   (Section A is compulsory. Then, choose either Section B or C)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

SECTION A

QUESTION 1 (30 marks)

A steel beam of 10.0 m span carries the loading as shown in Figure 1. Lateral restraint is provided at the supports and between A and B (due to insitu concrete slab). All the loadings and moments are ULTIMATE loadings and moments.

Draw the bending moment and shear force diagrams for the beam **[6 marks]**
Using Grade 43 steel, select a suitable universal beam section to satisfy:
a) bending requirement **[18 marks]**
b) shear requirement **[6 marks]**

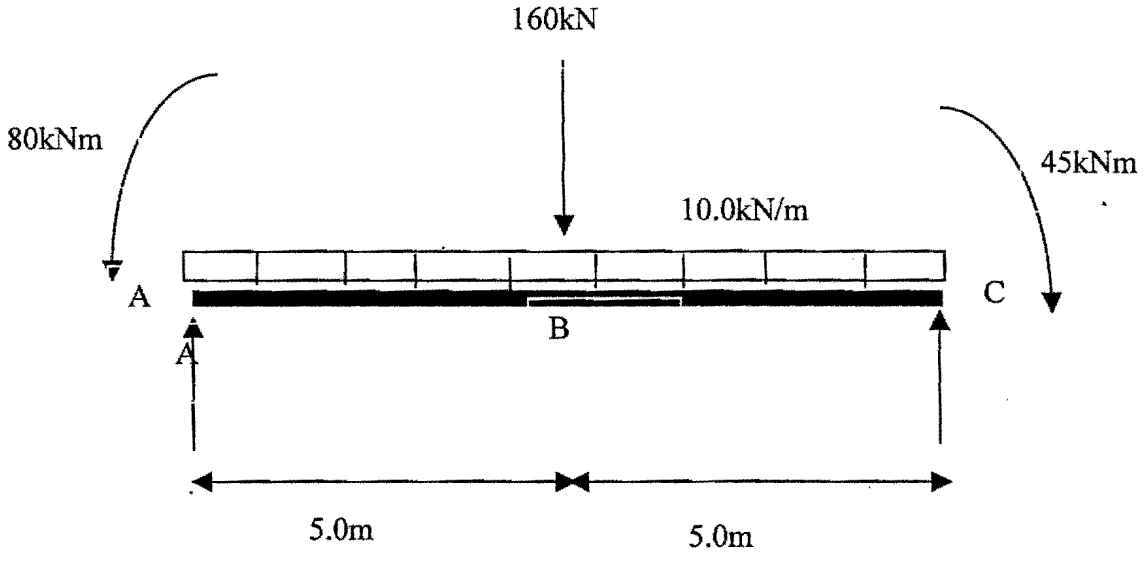


FIGURE 1

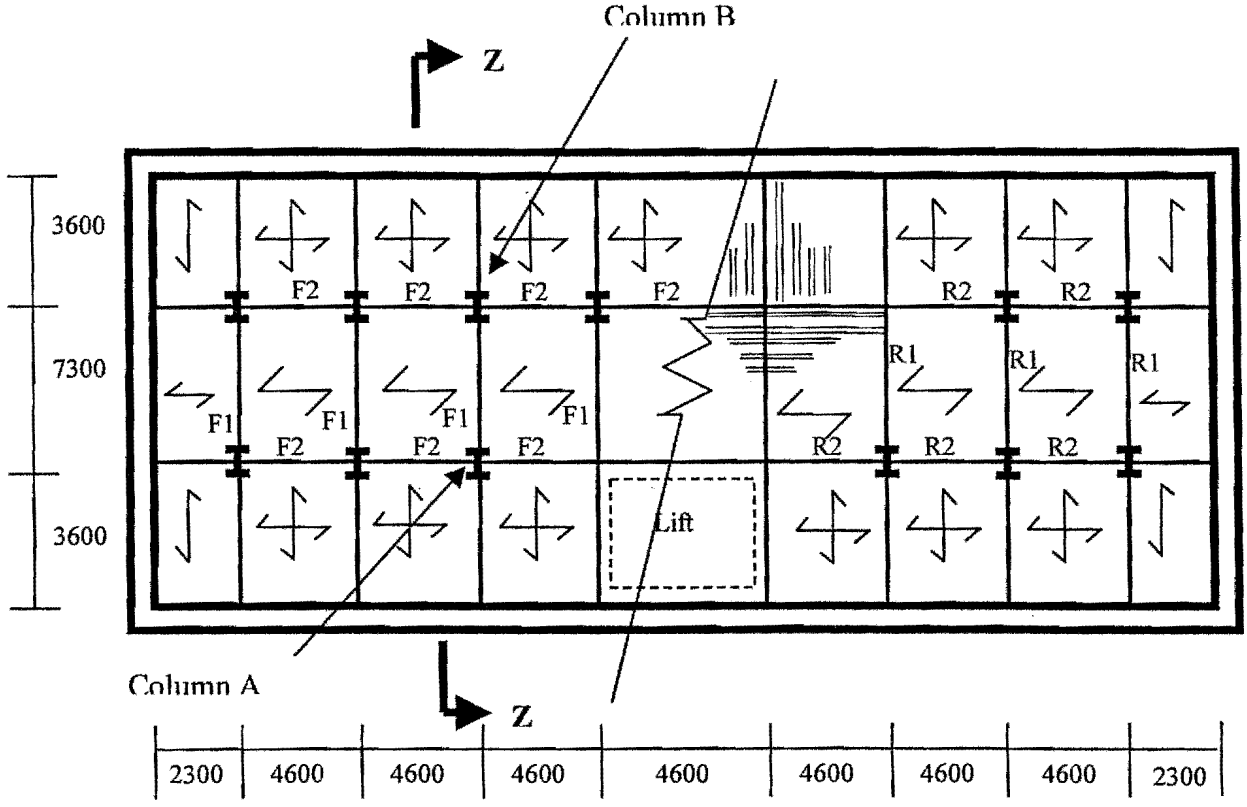
QUESTION TWO (40 marks)

The plan of the floor and roof for an office building and its cross-section are shown in Figures 2a and 2b. Column A is a steel 203 x 203 x 46 kg/m UC with uniform sectional properties throughout. The self-weight of the column is assumed to be 2 kN/floor. The design for the steel column is based on simple design. Based on this design, you are required to:

a) Find the loading area on the column A (**Note**: roof and floors have the same loading area **[5 marks]**
b) Find the loads on the column at the roof and at one of the floor levels (**Note**: roof and floors have the same loading area) **[6 marks]**

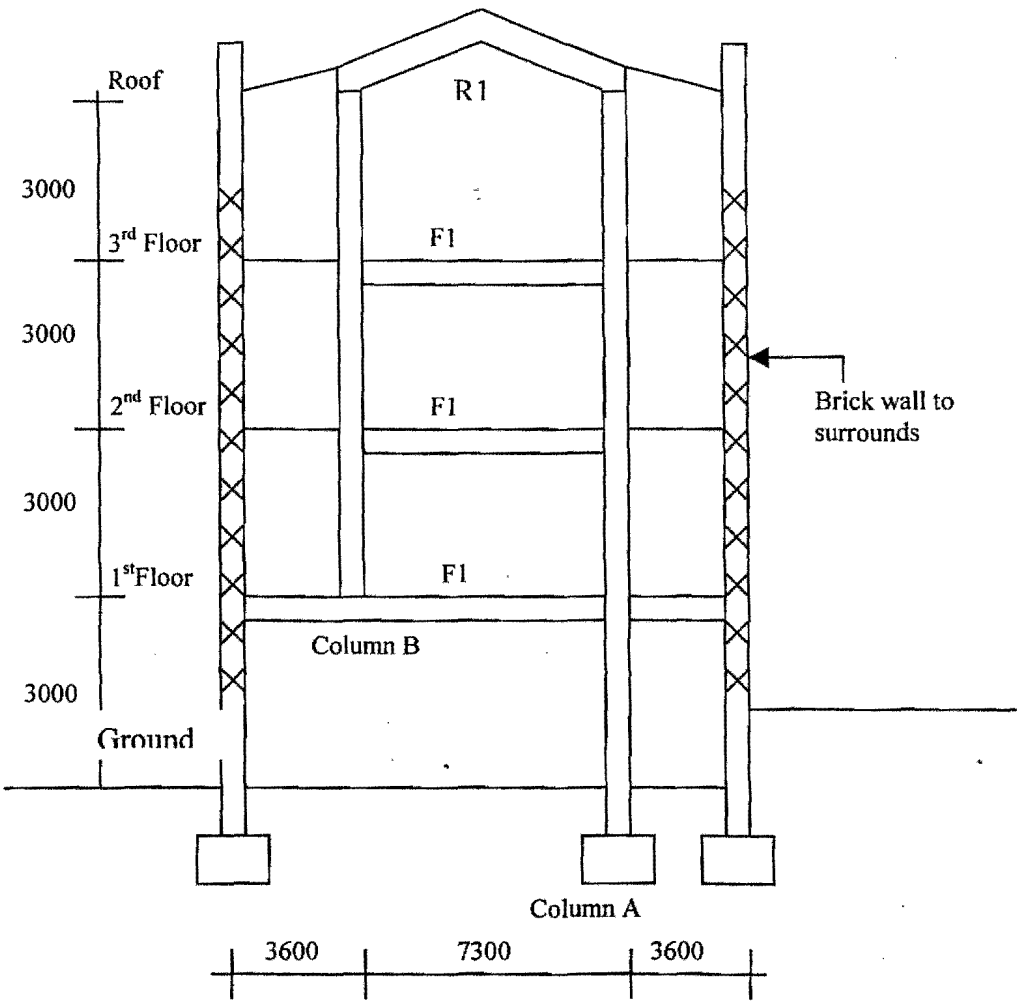
c) Find the maximum axial load and nominal moment for checking purposes in (d). **[9 marks]**

d) Check that the capacity of the column, A, has adequate capacity as a compression member **[20 marks]**



PART FLOOR PLAN **PART ROOF PLAN**

FIGURE 2(a)



SECTION Z-Z
FIGURE 2(b)

Roof Loading:
Superimposed Load = 0.75 kN/m2

Dead Load:
Chippings = 0.196 kN/m2
Felt = 0.098 kN/m2
Woodwool= 0.579 kN/m2
Timber Joist= 0.196 kN/m2
Ceiling = 0.098 kN/m2

Beam R1= 1.0 kN/m
Beam R2= 0.5 kN/m

Floor Loading:
Superimposed Load = 2.5 kN/m2

Dead Load:
Partitions= 1.0 kN/m2
Screed and Finishes = 0.579 kN/m2
Precast Units = 2.060 kN/m2
Ceiling Finishes= 0.245 kN/m2

Beam F1= 1.0 kN/m
Beam F2= 0.5 kN/m

SECTION B

QUESTION 3 (30 marks)

A roof truss is shown in Figure 3. The trusses are at 6.m centers, the length of the building is 36m and the height to the eaves is 5 m. The roof loadings are

Dead load = 0.40 kN/m^2 (on slope)
Imposed load = 0.75 kN/m^2 (on plan)
The wind load is to be estimated using CP3: Chapter V: Part 2. The building is located on the outskirts of a city and the basic wind speed is 45 m/s. Given that Cpi, internal pressure coefficient, is taken as +0.2 and –0.3. Determine the:

a) external pressure coefficient, Cpe, values for the roof. Hence the resultant Cp's for the roof surfaces **[5marks]**
b) external pressure coefficient, Cpe values for wall faces, C and D. Hence the resultant CP's for the wall surfaces **[5marks]**
c) Vs (designed wind speed) and '*q*' (dynamic pressure). Hence, find the designed wind loading (in kN) on the roof and the wall face **[10marks]**
d) Dead and Imposed load for the truss for primary analysis for internal and end panels **[5marks]**
e) Dead and Imposed load for the truss for moment in the top chord analysis (for internal and end purlins) **[5marks]**

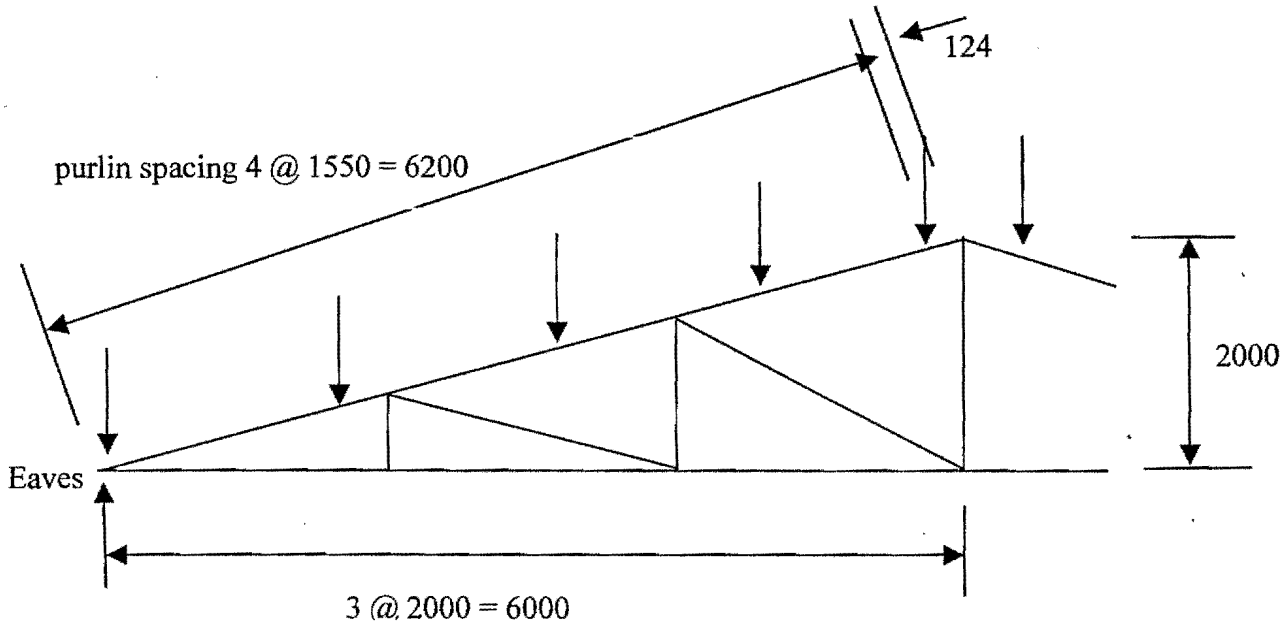


FIGURE 3 (Roof Cross-section)

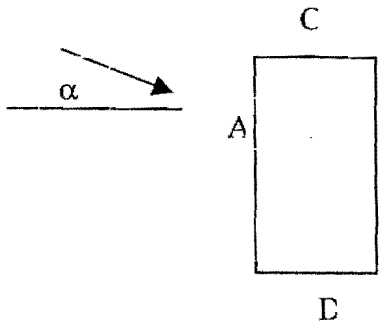


Figure 3
Plan View

SECTION C

QUESTION 4. [12 marks]

(Figure 2 is referred).
Find the total axial load until the first floor. Hence, check that the capacity of the column, B, a 203 x 203 x 46UC , is adequate as a TENSION member using the moment x-x axis and moment y-y axis calculated in Question 2 (c).

QUESTION 5 [8 marks]

A 203 X 203 X 46UC stanchion carries an 1000 KN ultimate load. Adopting a square base slab for its column base, determine the size and thickness required. The cube strength of the concrete grout is 35 N/mm^2. State any assumptions made.

QUESTION 6 [10 marks]

A single-shear bolted lap joint in Figure 4 is subjected to an ultimate tensile load of 300kN. Determine a suitable ordinary bolt diameter using Grade 4.6 that will pass the shear, bearing and tensile check.

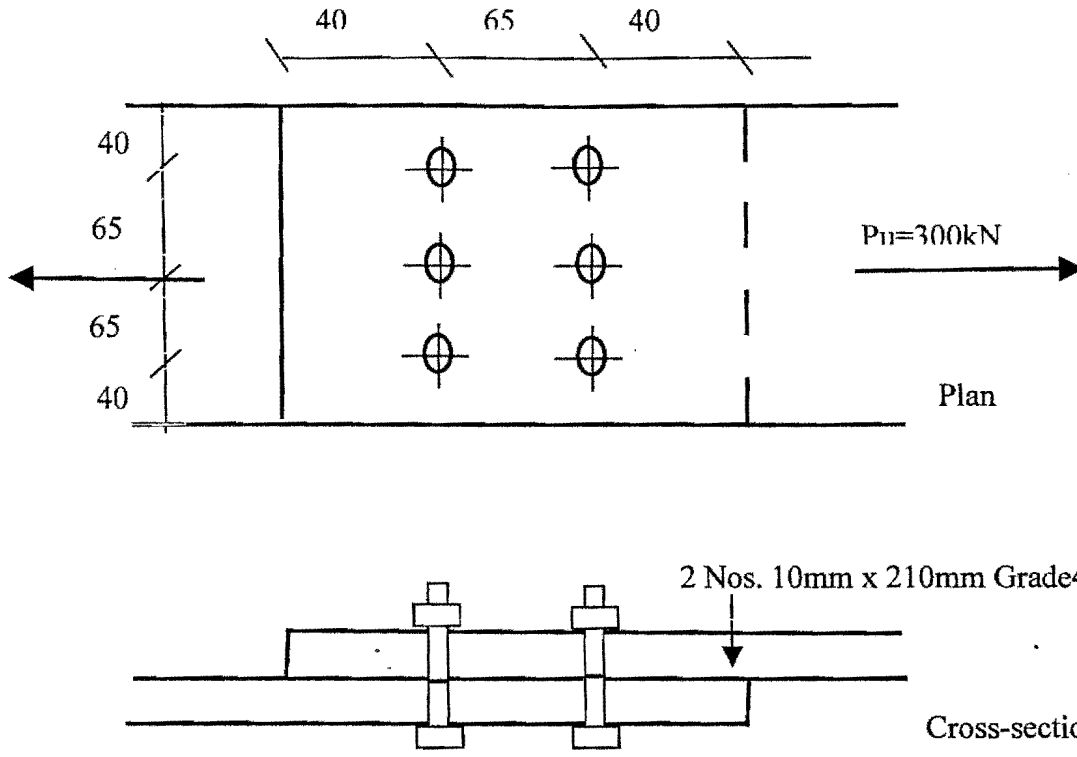

40
65
40
40
65
65
40
Pu=300kN
Plan
2 Nos. 10mm x 210mm Grade43 steel plate
Cross-section

Figure 4

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FAKULTI KEJURUTERAAN

(Faculty of Engineering)

Statik

(Statics)

KNS1013

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	20 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	2.00 pm- 5.00 pm
Tempat *(Place)*	:	Bilik Seminar 23	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Cik Norazzlina M.Sa'don			

Arahan *(Instruction)* :

1. **Pilih dan jawab empat soalan sahaja.**
   (Choose and answer four questions only)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

Question 1 (25 marks)

a) Convert: (i) 200 *lb.ft* to *N.m*, (ii) 350 lb/ft^3 to kN/m^3, (iii) 8 *ft/h* to *mm/s*. Express the result to three significant figures. Use appropriate prefixes.

(6 marks)

b) The screw eye is subjected to the two forces shown in Figure 1.

i) Express each force in Cartesian vector form

ii) Determine the resultant force. Find the magnitude and coordinate direction angles of the resultant force.

iii) Determine the coordinate direction angles of $\mathbf{F}_1$.

(19 marks)

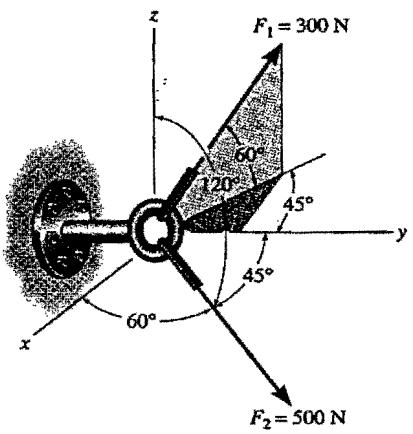

Figure 1

Question 2 (25 marks)

a) The 100 kg crate shown in Figure 2-a is supported by three cords, with one of the cords connected to a spring. Determine the tension in cords AC and AD and the stretch of the spring.

(12 marks)

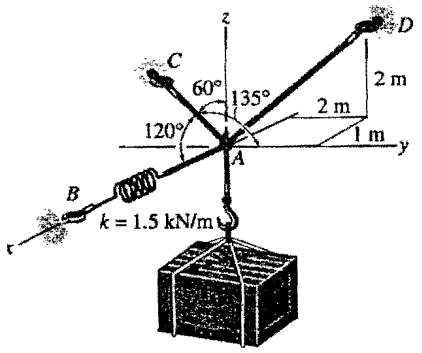

Figure 2-a

b) Determine the intensities w_1 and w_2 of the distributed loading acting on the bottom of the slab (Fig 2-b) so that this loading has an equivalent resultant force that is equal but opposite to the resultant of the distributed loading acting on the top of the plate.

(13 marks)

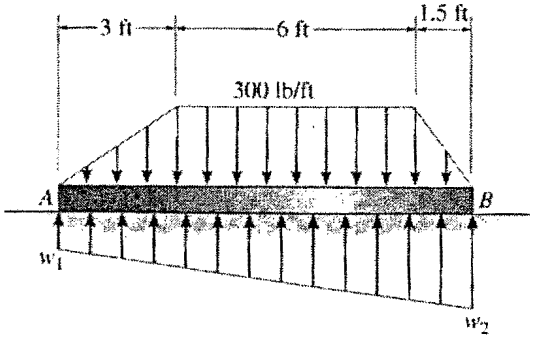

Figure 2-b

Question 3 (25 Marks)

a) Draw the free-body diagram of member AB shown in Figure 3-a, which is supported by a roller at A and a pin at B. Neglecting the effect of friction, determine the reactions at A and B.

(10 marks)

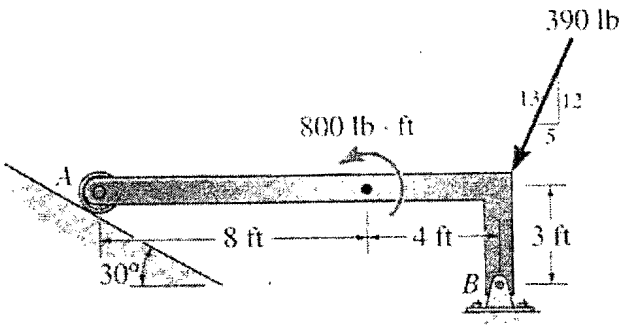

Figure 3-a

b) The *Howe truss* is subjected to the loading shown in Figure 3-b. Determine the force in members ***GC***, ***CD***, ***GF***, ***GD***, ***BC***, ***GH*** and ***BG*** of the truss and state if the members are in tension or compression.

(15 marks)

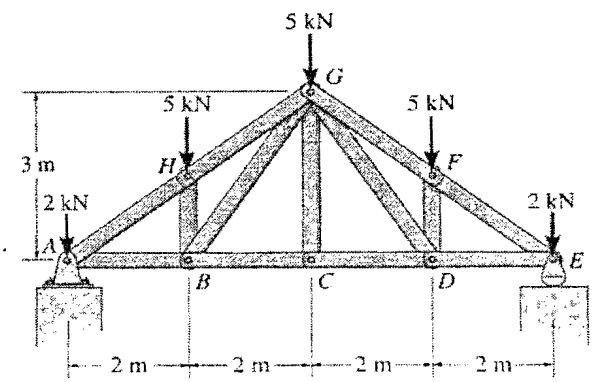

Figure 3-b

Question 4 (25 marks)

a) Describe the term *friction force*. State the two general characteristics of friction forces.

(6 marks)

b) The two blocks in Figure 4 are connected by a rod of negligible weight. Each blocks weighs 100 *lb*.

i) Find the maximum value of the force P, acting to the right or left, which may be applied to block A without causing a force in the connecting link.

ii) Find the minimum value of the horizontal force P, acting to the left on block A, which will cause impending motion of the system. What is the force in the link for this case?

iii) Do the same as in part (b) if the force acts to the left on block B instead of on block A.

(19 marks)

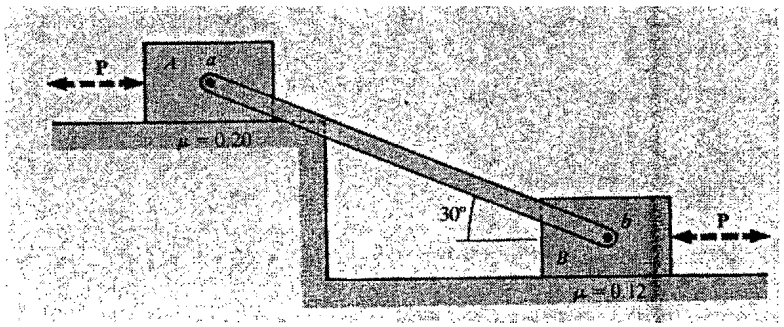

Figure 4

Question 5 (25 Marks)

a) Locate the centroid $(\bar{x}, \bar{y})$ of the shaded area in Figure 5.

(6 marks)

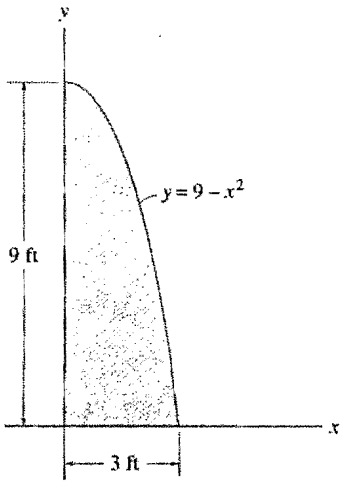

Figure 5-a

b) The plate has four holes drilled in it, as shown in Figure 5-b. Find the centroidal coordinates of the drilled plate. Organize the solution in a tabular form.

(19 marks)

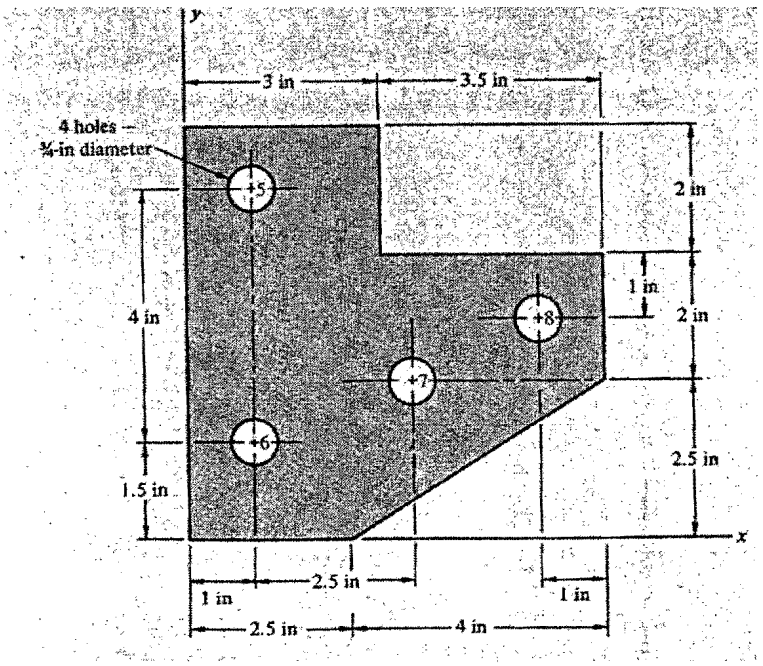

Figure 5-b

Question 6 (25 Marks)

a) Determine the moment of inertia of the shaded area by integration shown in Figure 6-a about the x-axis.

(5 marks)

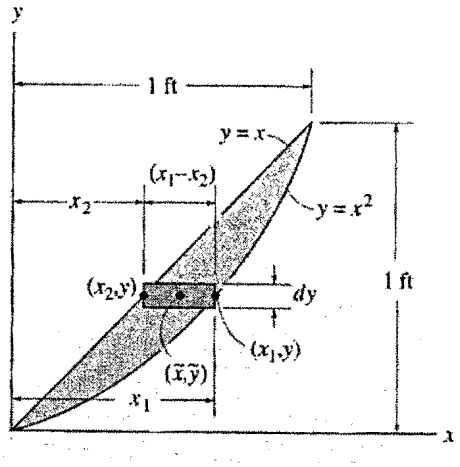

Figure 6-a

b) For the area shown in Figure 6-b, determine

i) The moments of inertia I_x and I_y of the area shown;

ii) The polar moment of inertia J of the area about the origin of the coordinates axes.

iii) The radii of gyration k_x, k_y, and k_p.

(20 marks)

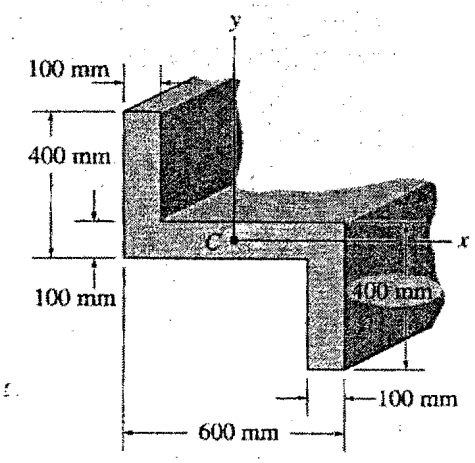

Figure 6-b

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94300 KOTA SAMARAHAN
SARAWAK

FAKULTI KEJURUTERAAN

(Faculty of Engineering)

Rekabentuk Konkrit Bertetulang

(Reinforced Concrete Design)

KNS 3174

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	20 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	2.00 pm – 5.00 pm
Tempat *(Place)*	:	Dewan Kuliah I	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	En. Abdul Razak Abdul Karim			

Arahan *(Instruction)* :

1. **Pilih dan jawab EMPAT (4) soalan sahaja.**
   (Choose and answer FOUR (4) questions only)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

QUESTION 1 (25 marks)

a) In optimization of design, dual concept of span/effective depth ratios and maximum design concrete shear stress can be used to determine the size of beam. Explain the dual concept stated above by illustrating an example of calculation of a simply supported beam with 7 m span and supports g_k = 18 kN/m and q_k = 13 kN/m. **(6 marks)**

b) The beam is 300 mm wide by 660 deep with three equal 5.0 m spans. In the transverse direction, the beams are at 4.0 m centres with a 180 mm thick slab, as shown in Figure 1.

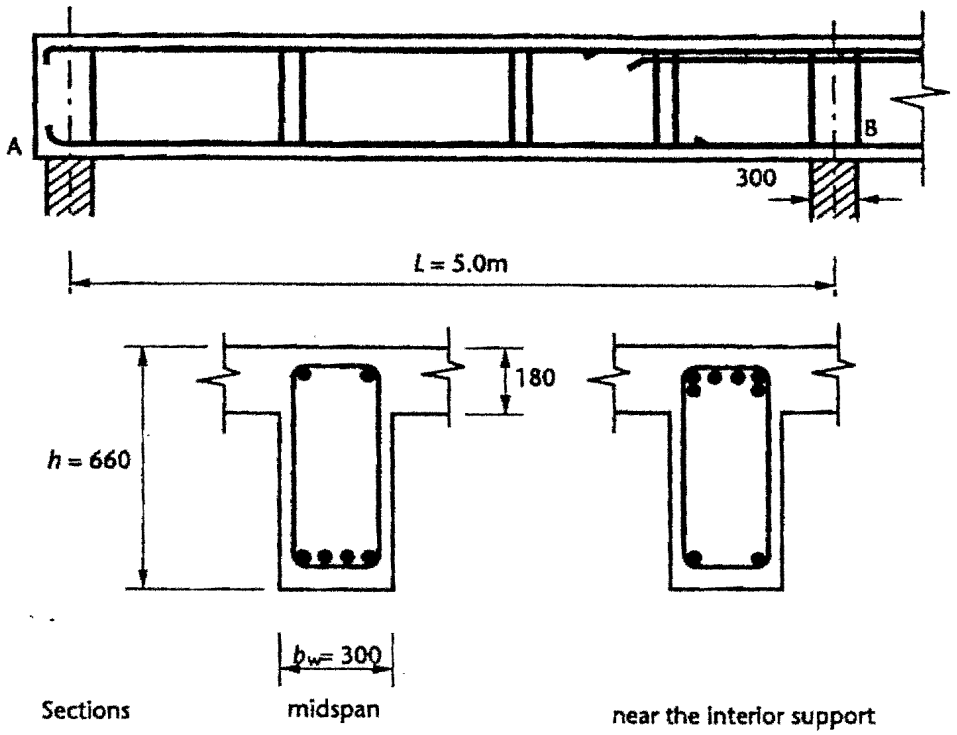

Figure 1

The live load q_k on the beam is 50 kN/m and the dead load g_k, including self-weight, is 85 kN/m.

Characteristic material strength are f_{cu} = 30 N/mm^2, f_y = 460 N/mm^2 for the longitudinal steel and f_{yv} = 250 N/mm^2 for the links. For a mild exposure the minimum concrete cover is to be 25 mm.

i. Determine the design ultimate bending moments and shear forces by using Table 3.5: BS 8110. **(4 marks)**

ii. Design the bending reinforcements of the beam. **(15 marks)**

State all assumptions made.

QUESTION 2 (25 marks)

a) In analyses of braced frames, a building frame shown in Figure 2.1 can be simplified into a series of substitute frames for analysis. Draw and discuss each of the substitute frames. **(12 marks)**

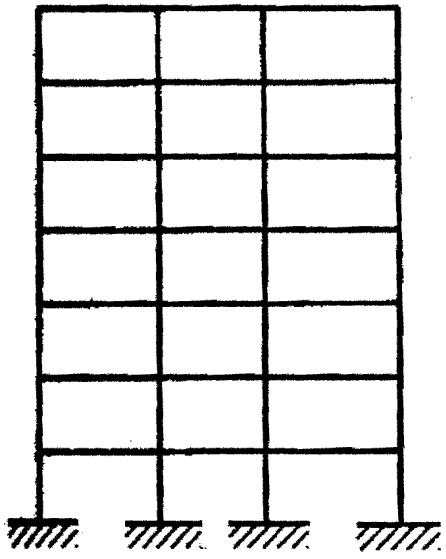

Figure 2.1

b) The substitute frame below is taken from the building frame in Figure 2.1. The loading to cause maximum column moments is shown in Figure 2.2 for G_k = 25 kN/m and Q_k =10 kN/m. Beams and columns size are 300 × 600 and 300 × 350 respectively.

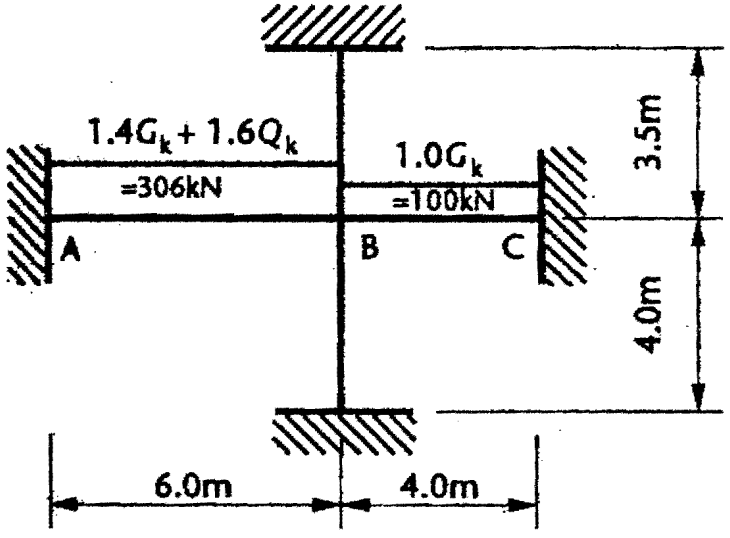

Figure 2.2

Determine the bending moment for upper and lower column by using the general equation of $M_{col} = \sum M_{col} \times \frac{k_{col}}{\sum k_{cols}}$ **(13 marks)**

QUESTION 3 (25 marks)

a) Briefly discuss the type of staircase given below

i. stairs spanning horizontally, and

ii. stair slab spanning longitudinally. **(6 marks)**

b) The stairs are of the type shown in Figure 3 spanning longitudinally and set into pockets in the two supporting beams.

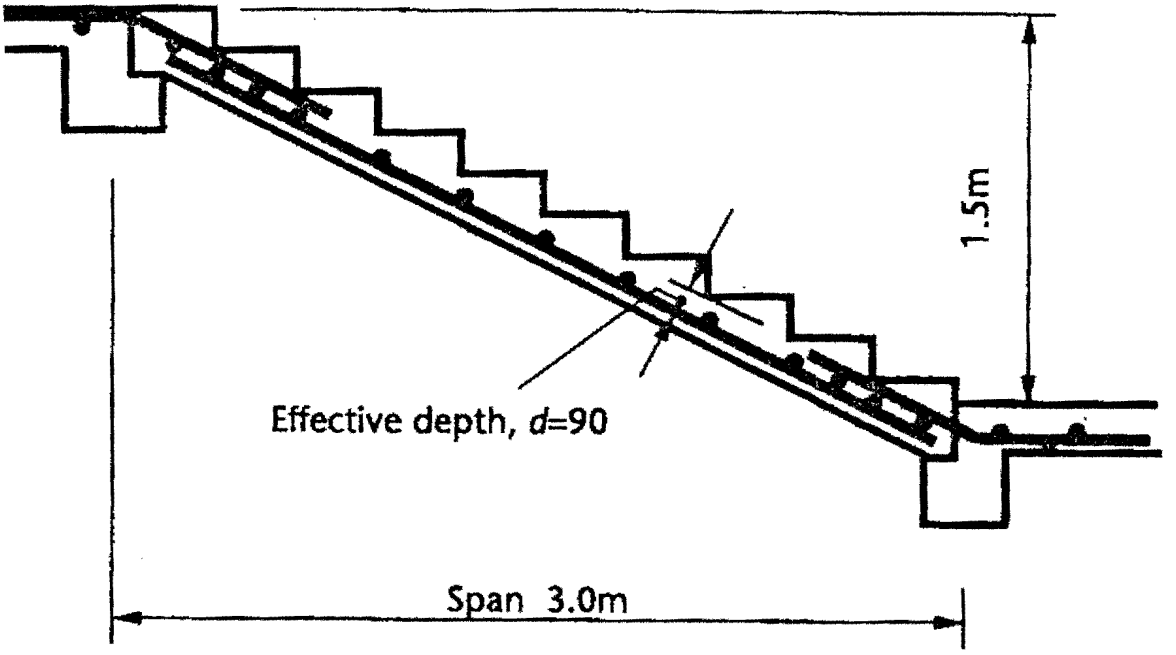

Figure 3

The live load is 3.0 kN/m^2 and the characteristic material strengths are f_{cu} = 30 N/m^2 and f_y = 250 N/m^2.

The effective span is 3 m and the rise of the stairs is 1.5 m, with 260 mm treads and 150 mm risers. Try a 125 mm thick waist with effective depth, d = 90 mm.

Design the bending reinforcement for the stair slab. **(19 marks)**

QUESTION 4 (25 marks)

A wall is subject only to a direct tensile working force of 265 kN/m due to hydrostatic loads. Determine a suitable thickness and reinforcement arrangement using high-yield bars f_y = 460 N/mm and grade C35A concrete for a 0.1 mm maximum crack width. Given that f_{ct} = 1.6 N/mm^2, E_s = 200 kN/mm^2, f_b = 2.4 N/mm^2, T_1 = 20°C, T_2 = 20°C, and $\alpha_c = 10 \times 10^{-6}$/°C. **(25 marks)**

QUESTION 5 (25 marks)

The cantilever retaining wall shown in Figure 4 supports a granular material of bulk density 1700 kg/m^3, and the allowable bearing pressure is 110 kN/m^2.

Given that $K_a = 0.33$, $g = 9.81$ m/s^2, $\mu = 0.45$ (at $h = 4.9$ m), $K_p = 3.0$, $\mu = 0.58$ (at $h = 5.5$ m), $\gamma_f = 1.6$ (for the lateral loadings), and minimum required surcharge pressure = 10 kN/m^2.

It is required to

a) check the stability of the wall, and **(20 marks)**

b) determine the actual bearing pressures. **(5 marks)**

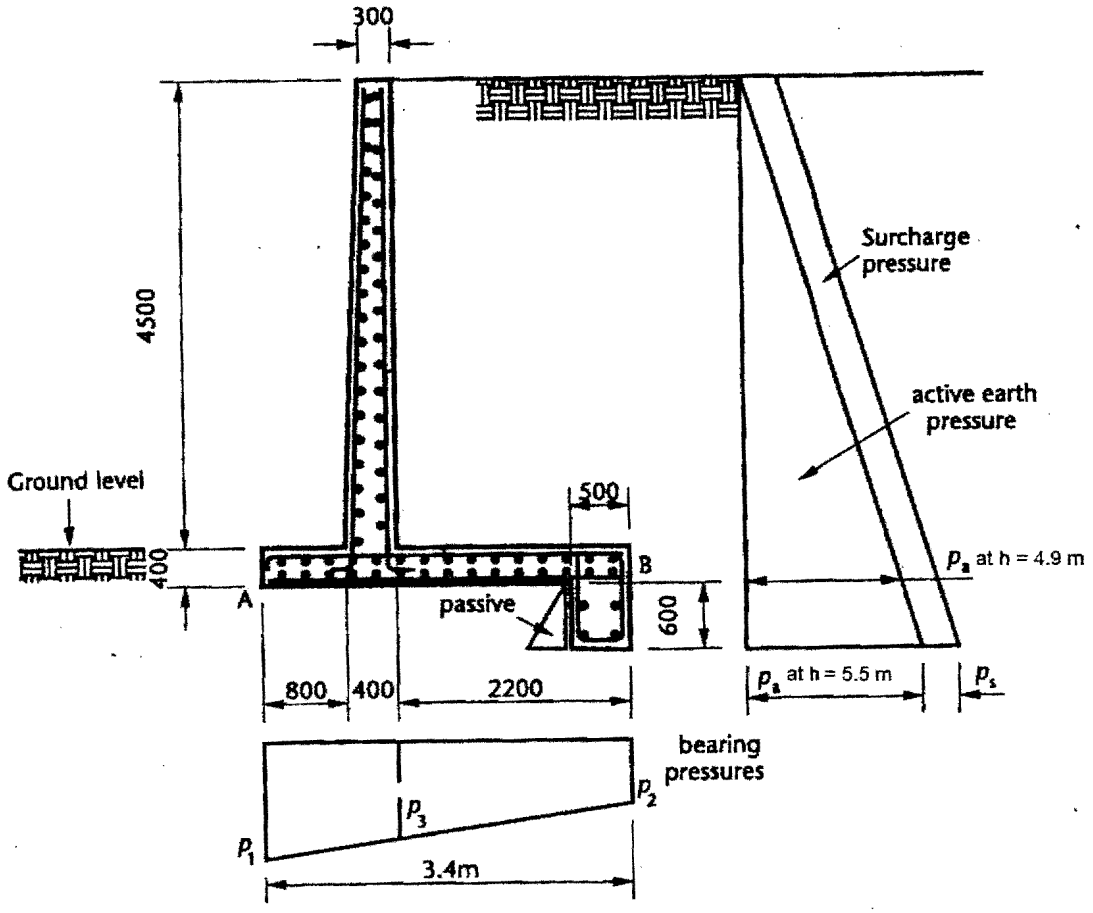

Figure 4

List of formulae:

$$w_{\max} = 3a_{cr}\varepsilon_m$$

$$\varepsilon_1 = \frac{tension\ force}{E_s A_s}$$

$$\varepsilon_2 = \frac{b_t h}{E_s A_s}$$

$$r = \frac{A_s}{A_c}$$

$$s_{\max} = \frac{f_{ct}\phi}{f_b 2r}$$

$$w_{\max} = s_{\max}\frac{\alpha_c}{2}(T_1 + T_2)$$

$$p_a = K_a \rho g h$$

$$\mu(1.0G_k + 1.0V_k) \geq \gamma_f H_k$$

$$p = \frac{N}{D} \pm \frac{6M}{D^2}$$

Table 1 Cross-sectional areas of groups of bars (mm^2)

Bar size	*Number of bars*									
(mm)	1	2	3	4	5	6	7	8	9	10
6	28.3	56.6	84.9	113	142	170	198	226	255	283
8	50.3	101	151	201	252	302	352	402	453	503
10	78.5	157	236	314	393	471	550	628	707	785
12	113	226	339	452	566	679	792	905	1020	1130
16	201	402	603	804	1010	1210	1410	1610	1810	2010
20	314	628	943	1260	1570	1890	2200	2510	2830	3140
25	491	982	1470	1960	2450	2950	3440	3930	4420	4910
32	804	1610	2410	3220	4020	4830	5630	6430	7240	8040
40	1260	2510	3770	5030	6280	7540	8800	10100	11300	12600

Table 2 Cross-sectional area per metre width for various bar spacing (mm^2)

Bar size	*Spacing of bars (mm)*								
(mm)	50	75	100	125	150	175	200	250	300
6	566	377	283	226	189	162	142	113	94.3
8	1010	671	503	402	335	287	252	201	168
10	1570	1050	785	628	523	449	393	314	262
12	2260	1510	1130	905	754	646	566	452	377
16	4020	2680	2010	1610	1340	1150	1010	804	670
20	6280	4190	3140	2510	2090	1800	1570	1260	1050
25	9820	6550	4910	3930	3270	2810	2450	1960	1640
32	16100	10700	8040	6430	5360	4600	4020	3220	2680
40	25100	16800	12600	10100	8380	7180	6280	5030	4190

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94300 KOTA SAMARAHAN
SARAWAK

FAKULTI KEJURUTERAAN

(Faculty of Engineering)

Rekabentuk Struktur Lanjutan

(Advanced Structural Design)

KNS 4303

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	19 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	2.00 pm– 5.00 pm
Tempat *(Place)*	:	Bilik Seminar 11	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Prof. Madya Dr. Ng Chee Khoon			

Arahan *(Instruction)* :

1. **Jawab semua soalan.**
   (Answer all questions)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

Question 1

A 20-m span pretensioned beam is prestressed with initial jacking force of 3000 kN. It has a straight tendon profile with eccentricity of 550 mm. Determine the coefficients of short-term and long-term prestress losses.

Tendon DATA:
Cross-sectional area, $A_{ps} = 2400$ mm^2
Modulus of elasticity, $E_{ps} = 200$ kN/mm^2
Characteristic strength, $f_{pu} = 1860$ N/mm^2

1000-hr steel relaxation test gives:
At 60% of f_{pu} = 1.0%
At 70% of f_{pu} = 2.5%
Relaxation factor = 1.5

Concrete beam DATA:
Cross-sectional area, $A_c = 423050$ mm^2
Specific weight = 24 kN/m^3
Moment of Inertia, $I = 93.64 \times 10^9$ mm^4
At transfer, $f_{ci} = 40$ N/mm^2
$E_{ci} = 30$ kN/mm^2
Creep coefficient, $\phi = 1.5$
Shrinkage strain of plain concrete = 200×10^{-6}
Exposure = external

[25%]

Question 2

Fig. Q2 shows a simply-supported, bonded post-tensioned concrete beam section with the following properties: $f_{cu} = 40$ N/mm^2; $E_c = 28$ kN/mm^2; $A_c = 490 \times 10^3$ mm^2; $I = 70.1 \times 10^9$ mm^4; $y_b = 556$ mm; $L = 25$ m; $f_{pu} = 1670$ N/mm^2; $E_{ps} = 200$ kN/mm^2; $F_i = 3132$ kN; $A_{ps} = 2502$ mm^2; and $\eta_L = 0.75$. Determine the ultimate moment of resistance of the beam.

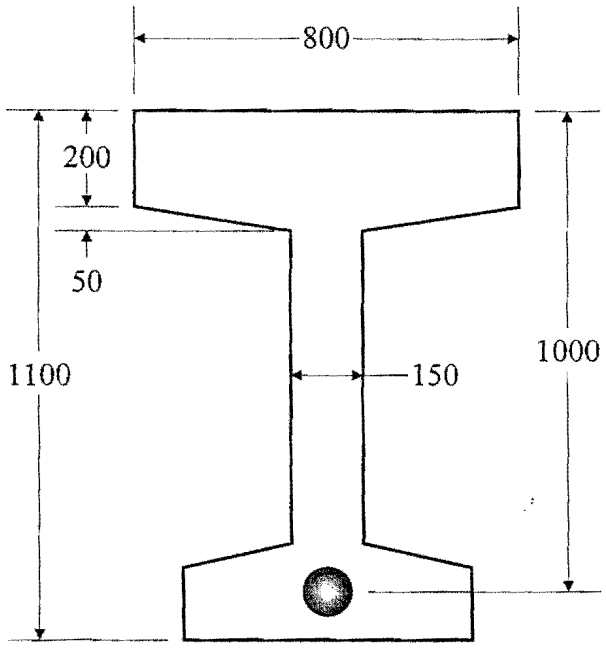


Fig. Q2

It is given that at ultimate limit state for T-section behaviour:

Prestressing tendon stress is

$$f_{pb} = \frac{0.45 f_{cu} bd}{A_{ps}} \left[\left(\frac{0.9\varepsilon_{cu}}{\varepsilon_{cu} + \varepsilon_{pb} - \varepsilon_{pe} - \varepsilon_{ce}} \right) \frac{b_w}{b} + \left(1 - \frac{b_w}{b} \right) \frac{h_f}{d} \right]$$

Neutral axis depth is

$$x = \left(\frac{\varepsilon_{cu}}{\varepsilon_{cu} + \varepsilon_{pb} - \varepsilon_{pe} - \varepsilon_{ce}} \right) d$$

Ultimate moment of resistance is

$$M_n = 0.405 f_{cu} b_w x(d - 0.45x) + 0.45 f_{cu} (b - b_w) h_f (d - 0.5 h_f)$$

[25%]

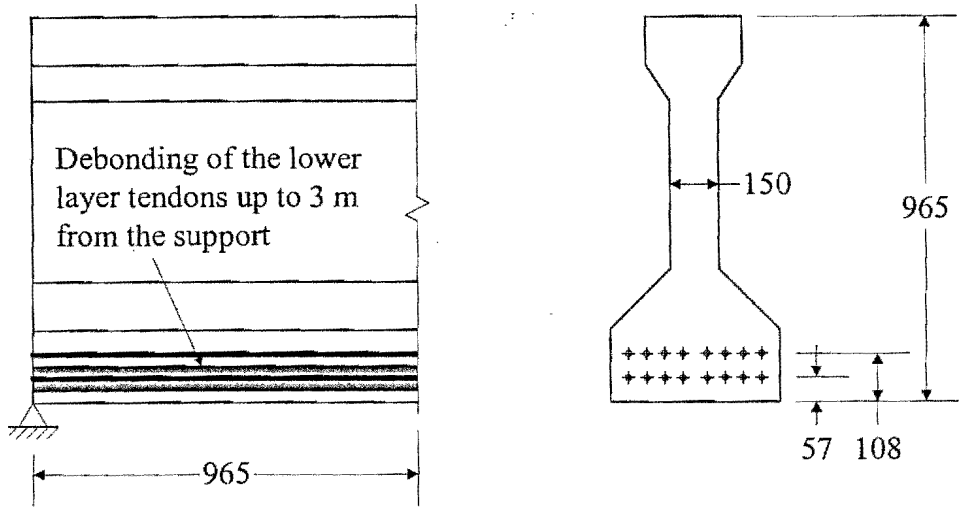
Question 3

The beam as shown in Fig. Q3 supports an ultimate load, including self-weight of 20.5 kN/m over a span of 16 m and has a final (effective) prestressing force of 1568 kN. Determine the shear reinforcement required based on the critical section at a distance equal to the beam depth h from the support. Use mild steel for the shear reinforcement, $f_{yv} = 250$ N/mm^2.

Tendon DATA:
Total cross-sectional area, $A_{ps} = 1600$ mm^2
Modulus of elasticity, $E_{ps} = 196$ kN/mm^2
Characteristic strength, $f_{pu} = 1860$ N/mm^2
Transmission length, $l_t = 585$ mm

Concrete beam DATA:
Cross-sectional area, $A_c = 272625$ mm^2
Moment of Inertia, $I = 28.15 \times 10^9$ mm^4
Section Modulii, $Z_t = 52.32 \times 10^6$ mm^3
$Z_b = 65.80 \times 10^6$ mm^3
Concrete strength, $f_{cu} = 40$ N/mm^2

Note: All dimensions in mm



(a) Front elevation at support (b) Cross section at midspan

Fig. Q3

[25%]

Question 4

Fig. Q4 shows the side elevation of end support of a post-tensioned beam which has a single anchorage of 400×400 mm bearing plate with a jacking force of 1800 kN. Determine the reinforcement required to contain the bursting forces based on BS8110 requirement. Assume the allowable stress in the bursting reinforcement as 150 N/mm^2 and the prestressing tendon is bonded.

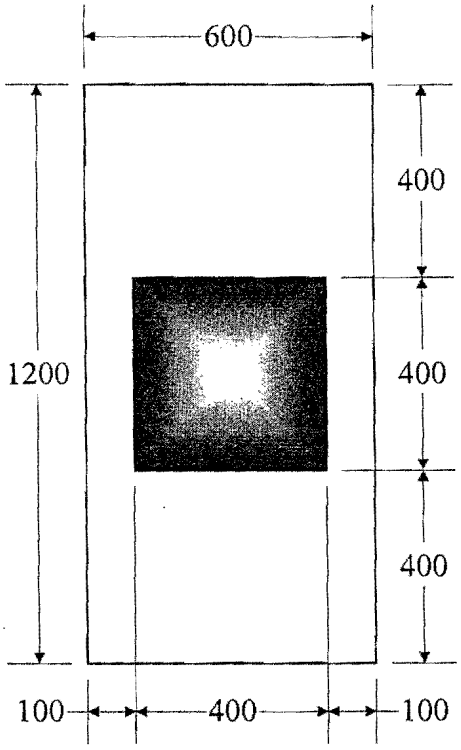


Fig. Q4

[25%]

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94300 KOTA SAMARAHAN
SARAWAK

FAKULTI KEJURUTERAAN
(Faculty of Engineering)

Bahan Kejuruteraan Sivil
(Civil Engineering Materials)

KNS 1043

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	18 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	9.00 – 11.00 am
Tempat *(Place)*	:	DK 1	**Jangkamasa** *(Duration)*	:	2 jam
Pensyarah *(Lecturer)*	:	Dr. Mohd Ibrahim Safawi			

Arahan *(Instruction)* :

1. **Jawab TIGA (3) soalan di Bahagian A dan SATU soalan di Bahagian B.**
   (Answer 3 questions in Section A and one question in Section B)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

BAHAGIAN A (*SECTION A*)

Question 1

(a) Pozzolan are inert materials, which in the presence of water, will combine with lime to produce a cementitious matter with excellent structural properties. Pozzolan are further classified as natural or artificial pozzolan. Name two artificial pozzolan and explain the advantages of using pozzolan.

[10 marks]

(b) The hydration of cement is an exothermic reaction forming several new products and releasing heat of hydration. Other than the formation of calcium silicate hydrates (C-S-H), describe briefly four other products of hydration.

[10 marks]

(c) Explain the nature of water in a hydrated cement paste.

[5 marks]

Question 2

(a) Natural sands may be subjected to three tests to establish their fitness for use in concrete. List the three tests noting briefly why they are necessary.

[6 marks]

(b) What does "bulking of sand," mean? Use graph to demonstrate your answer.

[4 marks]

(c) Outline the factors that influence the choice of aggregates for use in concrete.

[7 marks]

(d) Aggregates exist in four different moisture conditions. Sketch and describe these conditions and show the equation for measuring the absorption capacity, effective absorption, surface moisture and moisture content.

[8 marks]

Question 3

(a) The graphs and tables necessary for the calculation of concrete mix proportion are given at in the last few pages of this question paper. Calculate the mix design proportions for a grade 30 mix given the following:-

a. Coarse aggregate 20mm maximum size, uncrushed
b. Fine aggregate, 70% passing 600 micron, uncrushed
c. Ordinary Portland cement (OPC)
d. Slump 50 ± 25mm
e. Estimated wet density 2, 370 kg/m^3

The standard deviation for more than 20 cubes was 4.8 N/mm2. Assume 5% defectives and no exposure condition. In the laboratory class about 35kg of concrete is required for 12 cubes (100mm sides) and a small beam. Calculate the mass of components required for mixing

[18 marks]

(b) Given that the aggregates in the above mix have a total moisture content of 3.5% and absorption of 1.2%. Calculated the revised quantities in kg/m^3.

[7 marks]

Question 4

(a) There are special types of concrete available in the construction industry. These concrete are used for special purposes and applications. Explain the significance of the following concrete:

a. Structural lightweight concrete
b. High workability concrete
c. Shrinkage compensating concrete

[9 marks]

(b) Define the term "Durability of concrete". There are several causes for deterioration of hardened concrete. Explain four other types of physical or chemical attack on concrete.

[10 marks]

(c) Concrete strength can be described into several types. The most commonly used one is the compressive strength. Name three other types of strength that are also used with respect to concrete and give their respective estimate with respect to the compressive strength values.

[6 marks]

BAHAGIAN B (*SECTION B*)

Question 1

(a) Draw the stress-strain diagram for mild steel and explain the mechanical properties of mild steel when tensile test is carried out. Attention should be given to explain the following terms from the graph:-

a. Elastic modulus of steel
b. Proportional limit
c. Upper yield stress
d. Percentage elongation

[18 marks]

(b) Using diagram, explain the meaning of "Proof stress" and the reason for using it.

[7 marks]

Question 2

(a) What is timber seasoning and why is it necessary? Describe the two methods of seasoning timber.

[15 marks]

(b) There are numerous defects present in timber and these could arise from its natural growth and conversion process. Explain the meaning of the different defects given below:-

a. Knots
b. Wane
c. Distortions

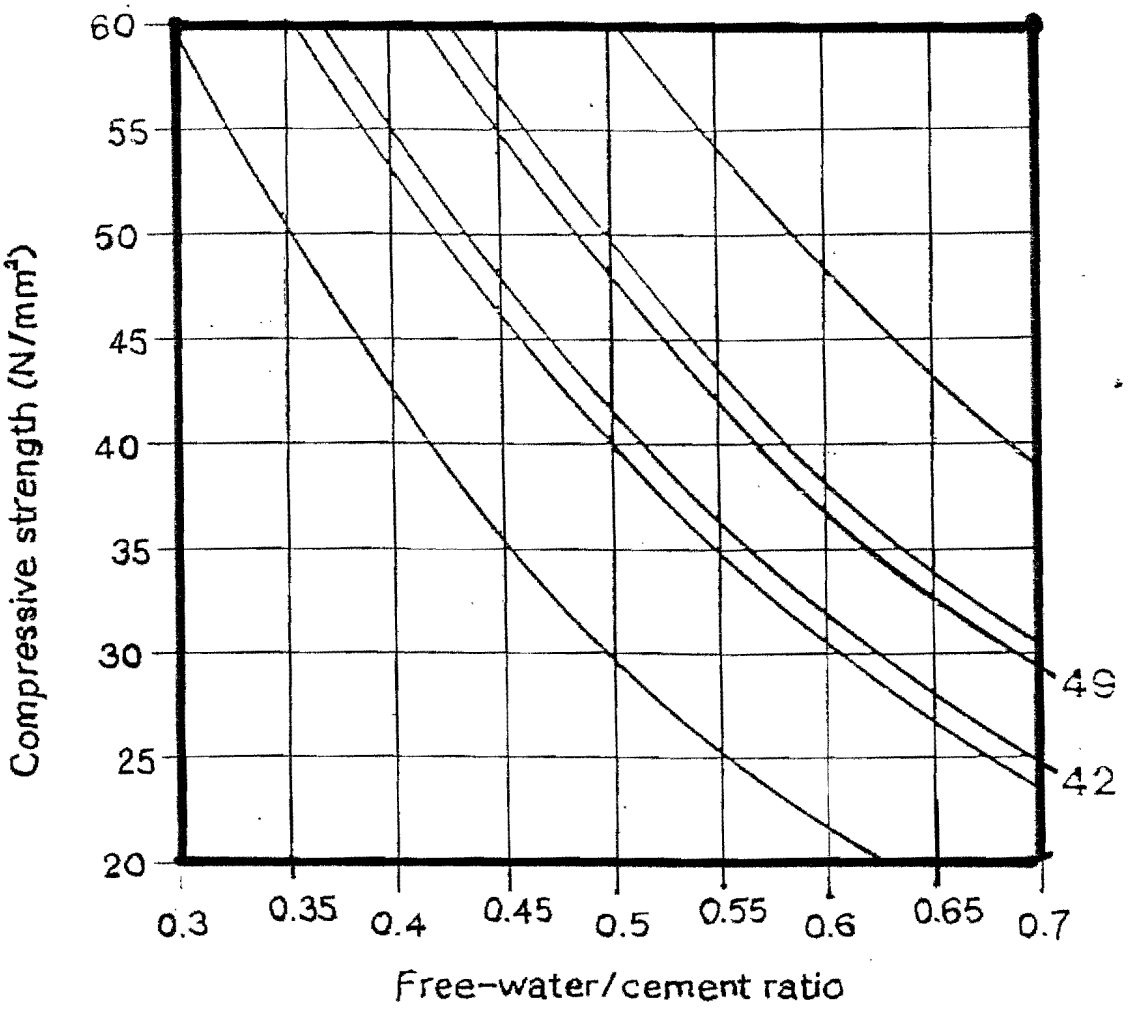
[10 marks]

Approximate Free Water Content Required to Give Various Levels of Workability According to the 1988 British Methods

Aggregate		Water Content (kg/m3) for				
Max. size (mm)	Type	Slump (mm)	0-10	10-30	30-60	60-180
		Vebe time (s)	>12	6-12	3-6	0-3
10	Uncrushed		150	180	205	225
	Crushed		180	205	230	250
20	Uncrushed		135	160	180	195
	Crushed		170	190	210	225
40	Uncrushed		115	140	160	175
	Crushed		155	175	190	205

Approximate Compressive Strength of Concrete Mde with a Free Water/Cement Ratio of 0.5. According to the 1988 British Method

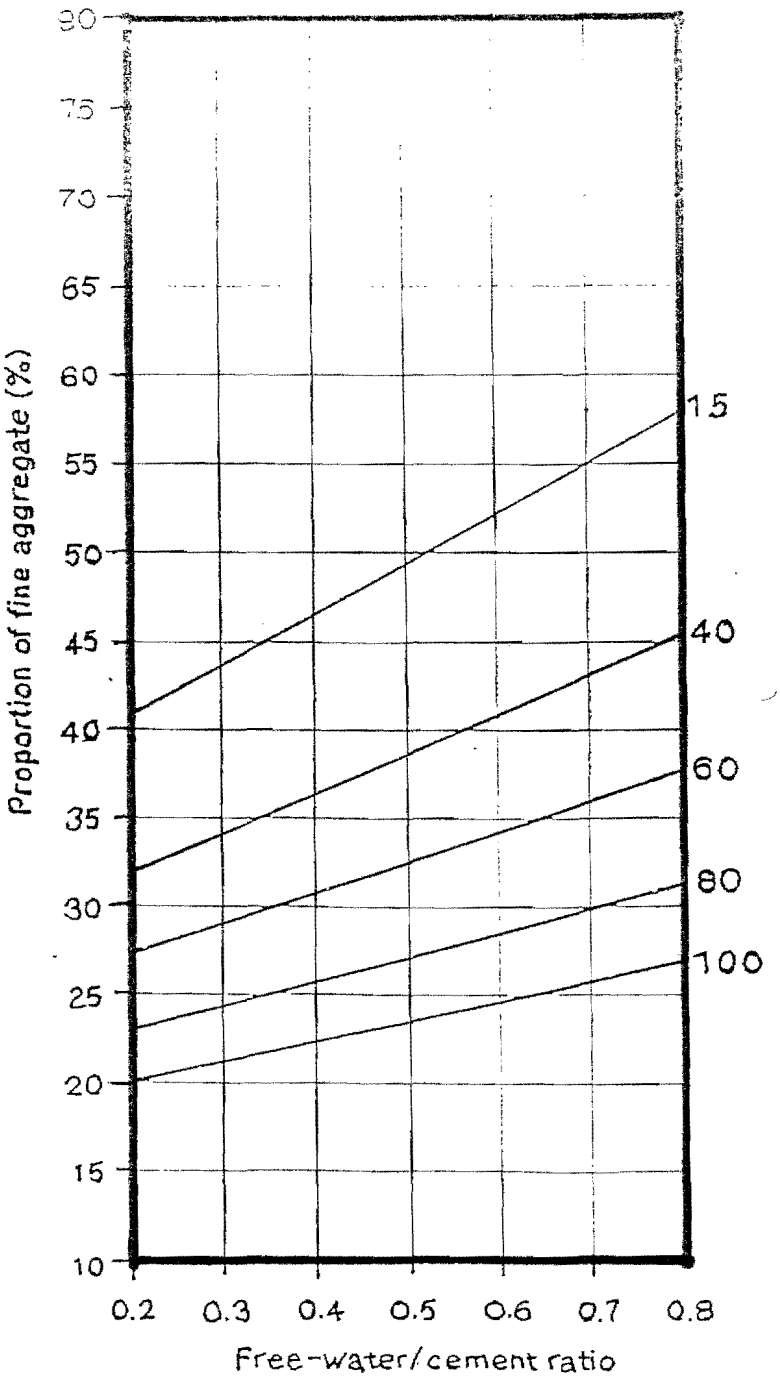
Type of cement	Type of coarse aggregate	Compressive strength (Mpa) at the age of (days)			
		3	7	28	91
Ordinary Portland (Type 1)	Uncrushed	22	30	42	49
Sulfate-resisting Portland (Type V)	Crushed	27	36	49	56
Rapid-hardening Portland (Type III)	Uncrushed	29	37	48	54
	Crushed	34	43	55	61



RELATIONSHIP BETWEEN COMPRESSIVE STRENGTH AND FREE-WATER/CEMENT RATIO

Maximum aggregate size : 20mm

Slump: 30-60
Vebe time: 3-6s



RECOMMENDED PROPORTIONS OF FINE AGGREGATE ACCORDING TO PERCENTAGE PASSING A 600 MICRON SIEVE

UNIVERSITI MALAYSIA SARAWAK

94300 KOTA SAMARAHAN
SARAWAK

FAKULTI KEJURUTERAAN

(Faculty of Engineering)

Kejuruteraan Air dan Air Sisa

(Water and Wastewater Engineering)

KNS 4233

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	16 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	9.00 am – 12.00 pm
Tempat *(Place)*	:	BS 23	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Dr. Law Puong Ling			

Arahan *(Instruction)* :

1. **Jawab Empat (4) soalan sahaja.**
   (Answer any four (4) questions only)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
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4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

Question 1.

A settling column analysis is run on a type-1 suspension for Batu Kitang Water Treatment Plant, Kucing. The settling column is 2 meters tall and the initial concentration of the well-mixed sample is 650 mg/L. Results of the analysis are shown below.

Time, minutes	0	58	77	91	114	154	256
Concentration remaining, mg/L	650	560	415	325	215	130	52

What is the theoretical removal efficiency of the settling basin that receives this suspension if the loading rate is 2.4×10^{-2} m/min? **[25 marks]**

Question 2.

Design a 30 feet tower trickling filter using a plastic packing to treat wastewater from Sejingkat Industrial Zone, Kuching in which a small vegetable cannery is located. Assume that the following information and data, derived from local records and pilot tests, apply. Assuming that a rotatory distributor will be used, also determine the rotational speed in rev/min for the summer and winter conditions. **[25 marks]**

Background Information

1. Average year-round domestic wastewater flowrate = 2.5MGD = 9460 m^3/d =1,736 gal/min.
2. Sustained peak seasonal cannery flowrate=1.25 MGD = 4,730m^3/d.
3. The canning season is May through October.
4. Average year-round domestic BOD = 220 mg/L.
5. Sustained peak combined domestic and cannery BOD =550 mg/L.
6. Effluent BOD requirement = 30 mg/L
7. Critical wastewater temperature data;
   Sustained temperature for May and October = 20°C.
8. Treatability constant = 0.10 $(gal/min)^{0.5}$ft. The treatability constant was derived from pilot plant studies conducted using a 20 feet test filter during the summer when the average temperature was 25°C.

Question 3.

Effluent from a primary treatment plant discharge from an 8-inch diameter pipe of an electronic manufacturing facility located in Sama Jaya Free Industrial Zone, Kucing into an intermittent stream. The characteristics of the effluent from the electronic manufacturing facility are;

Velocity:	0.6 ft/sec (flowing full)
BOD_5:	150 mg/L (20°C)
Dissolved oxygen, DO;	1.0 mg/L
Temperature:	22°C.

The characteristics of the intermittent stream are;

Flow:	2 ft^3/sec
Velocity:	0.2 ft/sec
BOD_5:	4 mg/L (20°C)
Dissolved oxygen, DO:	10.0 mg/L
Summer temperature:	52°F
Winter temperature:	45°F
Deaeration cofficient, K_D:	0.1/day
Reaeration cofficient, K_R:	0.25/day

1) Find the effluent volumetric flow rate. **[4 marks]**
2) Find the 5-day BOD immediately after mixing. **[4 marks]**
3) Find the dissolved oxygen immediate after mixing. **[4 marks]**
4) Find the temperature in the summer immediately after mixing. **[4 marks]**
5) Find the temperature in the winter immediately after mixing. **[4 marks]**
6) Find the DO concentration at a point 20 miles downstream. **[5 marks]**

Question 4.

Water at 25°C is passed through a filter bed at $12(10^{-3})$ m/sec. The bed is 0.75 m deep and is composed of non-uniform sand with specific gravity of 2.65 stratified so that the smallest particles are on top and larger on the bottom. The porosity and shape factors are 0.4 and 0.85 throughout the depth of the bed. The size distribution of the granules is given in the table below. Determine the head loss for clean water flow through the bed. **[25 marks]**

At temperature=25°C, ρ=997.0 kg/m^3, μ=0.89(10^{-3})N.s/m^2 or kg/m.s

Sieve Analysis

U.S. Sieve No.		Particle Size Range, mm		Average Size, dij, mm	Mass fraction in size range, Xij
Passing	Retained	Passing	Retained		
	14		1.41	1.41	0.01
14	20	1.41	0.84	1.13	0.11
20	25	0.84	0.71	0.78	0.20
25	30	0.71	0.60	0.66	0.32
30	35	0.60	0.50	0.55	0.21
35	40	0.50	0.42	0.46	0.13
40		0.42		0.42	0.02

Question 5.

The water of treatment plant for the town of Kapit receives 2 MGD of raw water intake from Batang Rajang with an average turbidity of 30 NTU.

a. Design a treatment sequence and indicate the functions of each of the components. **[5 marks]**
b. Draw a profile diagram showing the location and elevations of the treatment processes. Note that all elevations are approximate to provide gravity flow between the units. **[10 marks]**
c. Size settling basin(s) in your design. When sizing settling basins, the following assumptions should be made. The particles are fine sand and silt with specific gravities ranging from 1.2 to 2.65 and diameters ranging from 0.01-0.1 mm. For spherical particles with these characteristics, the settling velocity is typically $2(10^{-3})$ ft/sec. **[10 marks]**

UNIVERSITI MALAYSIA SARAWAK

94300 KOTA SAMARAHAN
SARAWAK

FAKULTI KEJURUTERAAN
(Faculty of Engineering)

Kejuruteraan Lebuh Raya dan Pengangkutan
(Highway and Transportation Engineering)

KNS 3183

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	18 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	9.00 am-12.00 pm
Tempat *(Place)*	:	Dewan Kuliah 1	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Ir. Resdiansyah Mansyur			

Arahan *(Instruction)* :

1. **Jawab semua soalan.**
   (Answer all questions)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

1.(a). From the Figure.1, using the headlight criterion, determine the station elevation of the PVC and PVT for a design speed of 120 kph. Assume fc =0.31, H = 0.67, headlight are aimed upward at an angle of 1 degree and draw a diagram with the values of your solution. ***12 points***

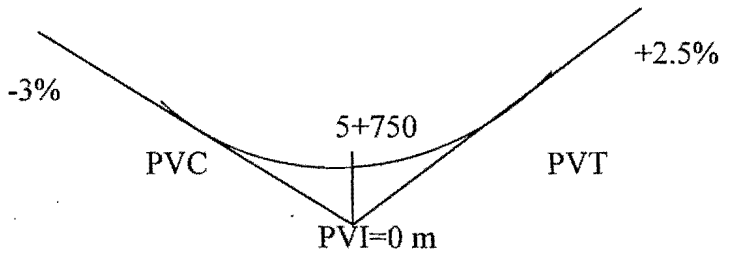

Figure. 1 A Sag Vertical Curve

(b). An existing vertical curve on a highway joint + 0 % grade with a – 4 % grade. If the length of the curve is 85 m, what speed limit should be posted in each direction on the curve? You may have different speed limit in each direction (round down to nearest 5 kph increment). Assume f= 0.4 and PRT 2.5 sec. ***10 points***

(c). A crest vertical curve on the freeway is designed for 120 km/hr. The grade on each slope (up and down) equals 1.5 %. If the tangents intersect at metric station 2 + 050.00 and at an elevation of 1000 meters, determine the stopping sight distance, the length of the curve, and the stations and elevations for the Beginning and End of the Vertical Curve. Assume h_1 = 1.1 m and h_2 0.15 m, perception reaction time is 2.5 second and f = 0.28 ***8 points***

(d). An engineering mistake has resulted in the need to connect an already constructed tunnel and bridge with a vertical curve. The profile of the tunnel and bridge is given in the Figure .2 below. Devise a vertical alignment to connect the tunnel and bridge for 20 mph design speed for the sag and crest (equal tangent) vertical curves needed. Assume that the final grade of the sag curves equals the initial grade of the crest curve. Compute stationing and elevation of PVC, PVI and PVT curve points.
Length of Curve: L_c =KA
Use any necessary assumptions and design tables provided ***(Table.2 and Table.3)***
12 points

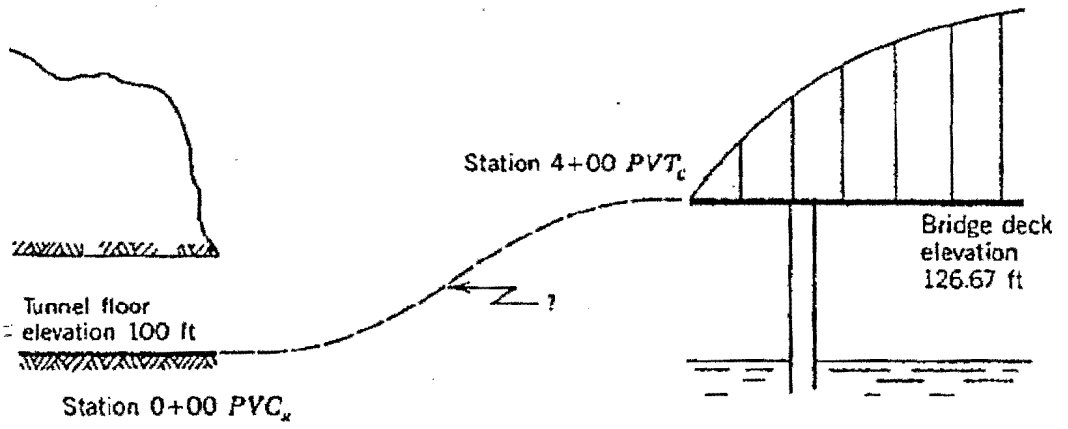

Figure.2. Profile view of vertical alignment diagram

2.(a). A horizontal curve is designed with a 500 m radius. The curve has a tangent of 250 m and the PI is at metric station 1+00. Determine the stationing of the PT and draw the curve with station. ***10 points***

(b). Figure.3 showed a flat horizontal curve on a 2-lane highway with a 200 m radius, 3.6 m lanes and 40° central angle.

(i). Determine the distance that must be cleared from *the inside edge of the inside lane* to provide sufficient Stopping Sight Distance.

(ii). What is the sight distance that must be cleared, if the curve is redesigned with a 150 m radius (All other criteria is equal)?Assume driver perception/reaction time 2.5 second and the stopping friction coefficient is 0.33. ***14 points***

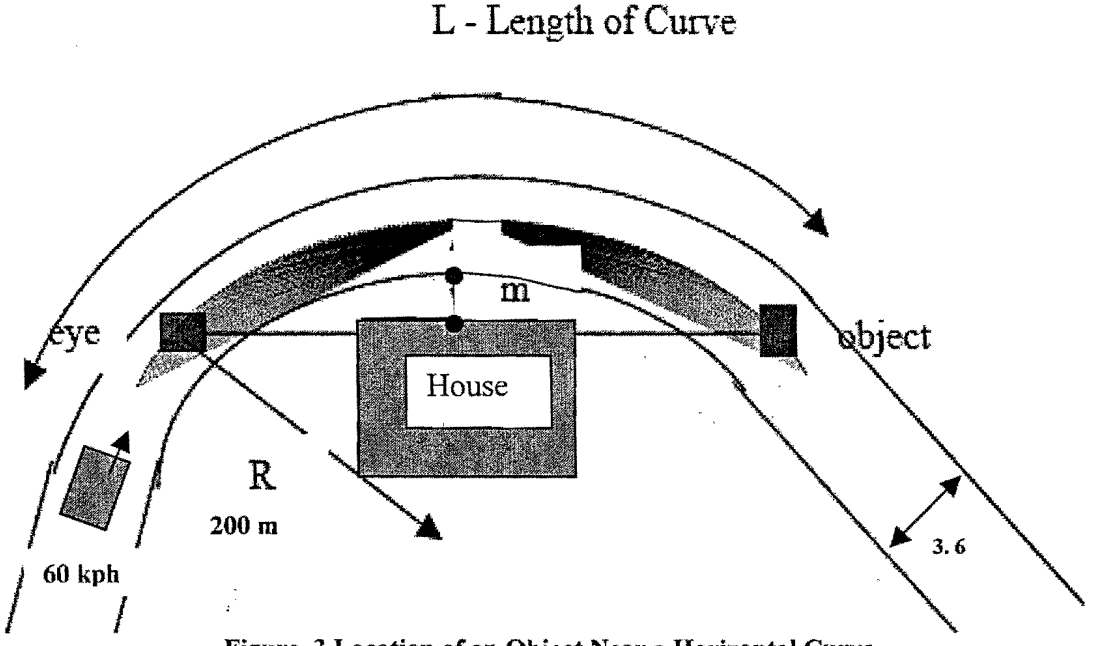

Figure. 3 Location of an Object Near a Horizontal Curve

3.(a). Identify 4 criteria used to set the minimum length of a sag vertical curve. Place them in order from most to least important. ***4 points***

(b). Fill in the blank on the Figure.4 below to identify the roadway cross-section elements. ***6 points***

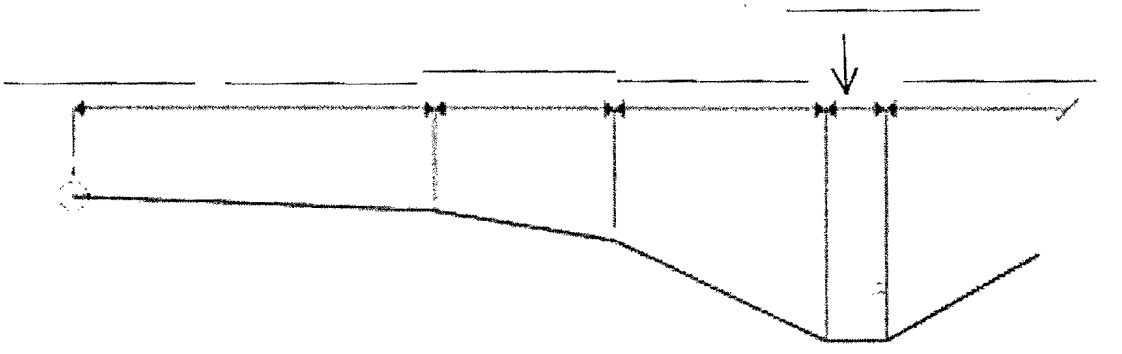

Figure. 4 Roadway Cross-Section

4.(a). A major arterial meets an interstate freeway running along Sarawak River at a Y intersection as shown in the Figure.5 below. Assuming that all traffic movements from and to the freeway are heavy traffic. Neatly sketch all ramps to transfer traffic. Show all directional movement by arrow and show all bridge (interchange/flyover) structure. Construction of ramps over or near the river is prohibited. ***10 points***

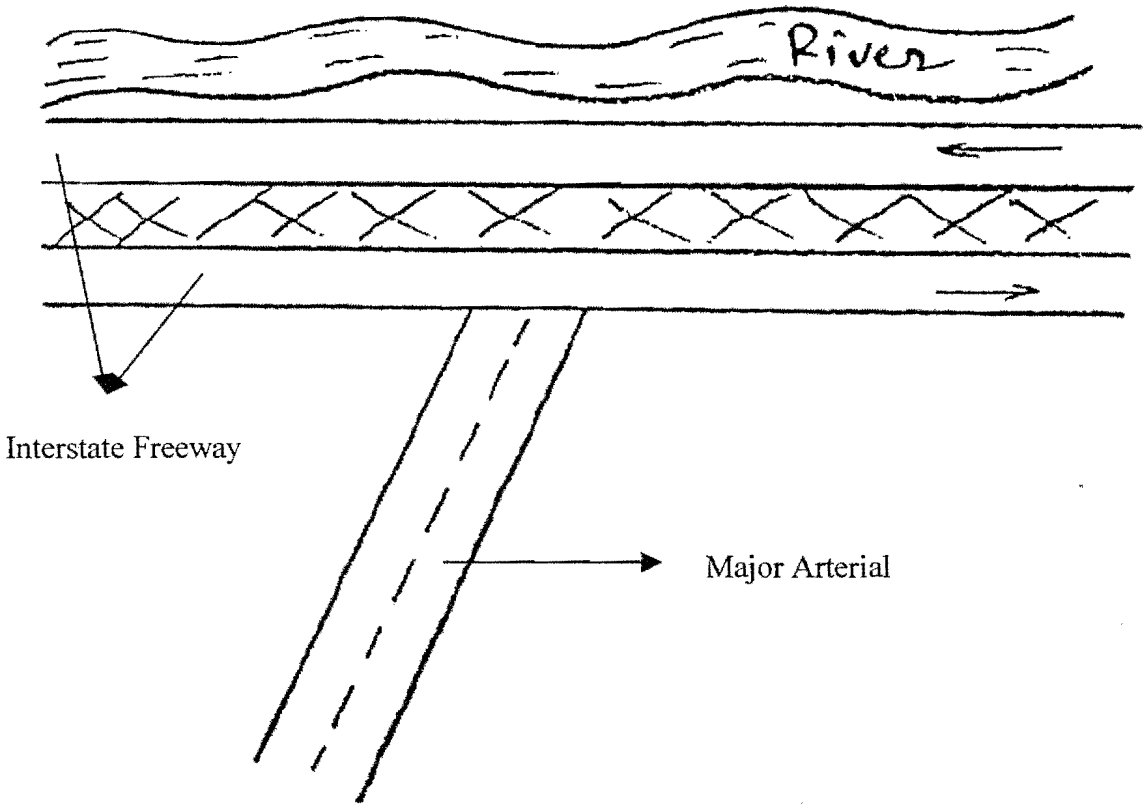

Figure. 5 Y Intersections

(b). A collector street joins an arterial at a 4-legged intersection. The collector has a STOP control on the collector legs. Draw an appropriate diagram, and identify all potential conflict points. ***8 points***

5. A flexible pavement is constructed with 4in. of hot mix asphalt wearing surface, 8in. of emulsion/aggregate-bituminous base, and 8in. of crushed stone subbase. Drainage coefficient of base and subbase is 0.7 and 1.0 respectively. Determine the pavement's structural number. What must m_2 be to ensure that the SN is greater than 5.0

6 points

Formula Given:

$$SSD = d = 0.278tV + \frac{V^2}{254(f \pm G)}$$

$$m = R\left(1 - \cos\frac{28.65S}{R}\right)$$

$$T = R\tan\left(\frac{\Delta}{2}\right)$$

$$L = \frac{R\Delta\pi}{180}$$

$$L = 2S - \frac{200\left(\sqrt{h_1} + \sqrt{h_2}\right)^2}{A}$$

$$L = \frac{AS^2}{200\left(\sqrt{h_1} + \sqrt{h_2}\right)^2}$$

$$L = 2S - \frac{200(H + S\tan\beta)}{A}$$

$$L = \frac{AS^2}{200(H + S\tan\beta)}$$

$$SN = a_1D_1 + a_2D_2M_2 + a_3D_3M_3$$

Table.1 Structural Coefficient

Table	
Pavement Component	Coefficient
Wearing Surface	
Sand-mix asphaltic concrete	0.35
Hot-mix asphaltic concrete	0.44
Base	
Crushed stone	0.14
Dense graded crushed stone	0.18
Soil cement	0.20
Emulsion/aggregate bituminous	0.30
Portland-cement aggregate	0.40
Lime-pozzolan/aggregate	0.40
Hot-mix asphaltic concrete	0.40
Subbase	
Crushed stone	0.11

Table.2 Design control for Crest Vertical

Design Controls for Crest Vertical Curves Based on Stopping Sight Distance

Design Speed (mph)	Assumed Speed for Condition (mph)	Coefficient of Friction, f	Stopping Sight Distance, Rounded for Design (ft)	Rate of Vertical Curvature, K[a] (length in feet per % of A)	
				Computed[b]	Rounded for Design
20	20–20	0.40	125–125	8.6–8.6	10–10
25	24–25	0.38	150–150	14.4–16.1	20–20
30	28–30	0.35	200–200	23.7–28.8	30–30
35	32–35	0.34	225–250	35.7–46.4	40–50
40	36–40	0.32	275–325	53.6–73.9	60–80
45	40–45	0.31	325–400	76.4–110.2	80–120
50	44–50	0.30	400–475	106.6–160.0	110–160
55	48–55	0.30	450–550	140.4–217.6	150–220
60	52–60	0.29	525–650	189.2–302.2	190–310
65	55–65	0.29	550–725	227.1–394.3	230–400
70	58–70	0.28	625–850	282.8–530.9	290–540

[a]Different K values for the same speed result from using unequal coefficients of friction.
[b]Using computed values of stopping sight distance.

Table.2 Design control for Sag Vertical

Design Controls for Sag Vertical Curves Based on Stopping Sight Distance

Design Speed (mph)	Assumed Speed for Condition (mph)	Coefficient of Friction, f	Stopping Sight Distance, Rounded for Design (ft)	Rate of Vertical Curvature, K[a] (length in feet per % of A)	
				Computed[b]	Rounded for Design
20	20–20	0.40	125–125	14.7–14.7	20–20
25	24–25	0.38	150–150	21.7–23.5	30–30
30	28–30	0.35	200–200	30.8–35.3	40–40
35	32–35	0.34	225–250	40.8–48.6	50–50
40	36–40	0.32	275–325	53.4–65.6	60–70
45	40–45	0.31	325–400	67.0–84.2	70–90
50	44–50	0.30	400–475	82.5–105.6	90–110
55	48–55	0.30	450–550	97.6–126.7	100–130
60	52–60	0.29	525–650	116.7–153.4	120–160
65	55–65	0.29	550–725	129.9–178.6	130–180
70	58–70	0.28	625–850	147.7–211.3	150–220

[a]Different K values for the same speed result from using unequal coefficients of friction.
[b]Using computed values of stopping sight distance.

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94300 KOTA SAMARAHAN
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FAKULTI KEJURUTERAAN
(Faculty of Engineering)

Mekanik Tanah
(Soil Mechanics)

KNS2123

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	19 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	9.00 am-12.00 pm
Tempat *(Place)*	:	Bilik Seminar 11	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Dr. Prabir Kumar Kolay			

Arahan *(Instruction)* :

1. **Semuanya ada tujuh soalan. Jawab soalan no.1 dan empat soalan lain.**
   *(There are **seven** questions. Answer questions **no. 1** and **four** other questions)*
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

*There are SEVEN questions. Answer **QUESTION NO. 1** and **ANY FOUR** from the rest.*

(Assume reasonable value(s) of any data, if missing. Answer should be brief and to the point. The figures in the margin indicate full marks)

1. Answer any **10 (TEN)** of the following questions **(COMPULSORY)** **[10 × 3]**

   (i) Define (a) void ratio, (b) degree of saturation, and (c) bulk density of a soil sample.

   (ii) What is optimum moisture content (OMC) in a standard Proctor test? Define relative compaction?

   (iii) What are the various factors that affect co-efficient of permeability?

   (iv) State the assumptions used in deriving Boussinesq's equation in stress distribution of soil.

   (v) What is 'neutral' and 'effective' stress in soils?

   (vi) State the different methods of soil classification systems. What do GC & SM stand for in Unified Soil Classification System (USCS)?

   (vii) What are the salient characteristics of flow net?

   (viii) Define (a) thixotropy, (b) sensitivity and (c) activity number

   (ix) Indicate the methods by which in-situ density can be measured. What is relative density?

   (x) The porosity of a sample of sand in the loose state is 54%. Find out the critical hydraulic gradient if the specific gravity of the soil grain is 2.6.

   (xi) State the three main mineral groups found in clay soil. Among them which one is having maximum swelling & shrinkage property?

   (xii) A soil has a plastic limit of 25% and a plasticity index of 30. If the natural water content of the soil is 34%, what is the liquidity index?

   (xiii) State at least two methods by which permeability of the soil can be determined at the laboratory. Which method is suitable for measuring the permeability of coarse-grained soil?

   (xiv) The results obtained from a grain-size distribution graph are: D_{10} = 0.06 mm, D_{30} = 0.20 mm and D_{60} =0.40 mm, find out the uniformity co-efficient (C_u) and co-efficient of curvature (C_c).

   (xv) State different methods for finding out the liquid limit of soil.

2. (a) Distinguish between residual soil & transported soil? Describe briefly the different soil structures and fabrics in coarse-grained and fine-grained soils. [7.5]

(b) The in-situ void ratio of a soil, e = 0.72 and specific gravity, G_s = 2.61. Calculate the porosity, dry unit weight, and the saturated unit weight. What would be the moist unit weight if the degree of saturation is S_r = 60%? [10]

3. (a) What do you understand by the term "consistency" of a soil? Discuss briefly, how do you express the consistency of a soil? [7.5]

(b) Classification tests were done on a soil sample and the following results were obtained.

Grain size test results

Percent finer than 4.75 mm = 96

Percent finer than 2 mm = 60

Percent finer than 0.425 mm = 30

Percent finer than 0.075 mm = 10

Consistency test results of soil fraction finer than 0.425 mm

Liquid limit (%) = 40

Plastic limit (%) = 20

Classify the soil using Unified Soil Classification Systems. [10]

4. (a) Derive an expression for the co-efficient of permeability as obtained from variable head permeameter. [7.5]

(b) A stratified soil deposit consists of three layers as shown in Fig.4.1. Given that

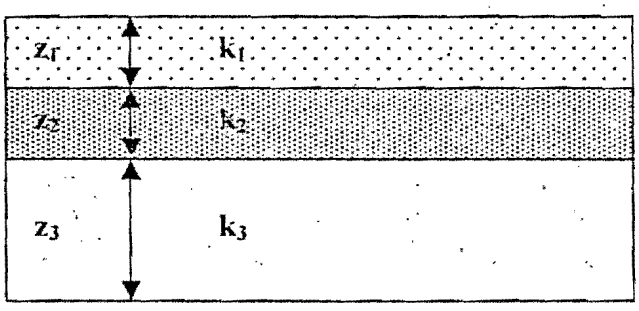

Fig. 4.1 for question no. 4 (b)

z_1 = 1 m, z_2 = 1 m, z_3 = 2 m and $k_1 = 1 \times 10^{-4}$ cm/sec, $k_2 = 3 \times 10^{-4}$ cm/sec and $k_3 = 4 \times 10^{-4}$ cm/sec. Find the effective average permeability of the deposit in horizontal and vertical directions. [10]

5. (a) What are the various factors that affect the compaction of soil? What are the main differences between laboratory standard and modified Proctor compaction tests? [7.5]

(b) The following results were obtained from a laboratory standard Proctor compaction test.

Water content (%)	8.1	9.9	12.0	14.3	16.1	18.2
Wt. of Mould + wet soil (kg)	2.783	3.057	3.224	3.281	3.250	3.196

The weight of the compaction mould was 1.130 kg and the soil had a specific gravity of 2.70. The volume of the mould was 1000 cm^3. Plot the compaction curve and determine the optimum moisture content. [10]

6. (a) Compute the total stress, effective stress and pore pressure at a depth of 15m below the bottom of a lake 6m deep as shown in Fig. 6.1. The bottom of the lake consists of soft clay with a thickness of more than 15m. The average water content of the clay is 40% and the specific gravity of soils may be assumed to be 2.65. [10]

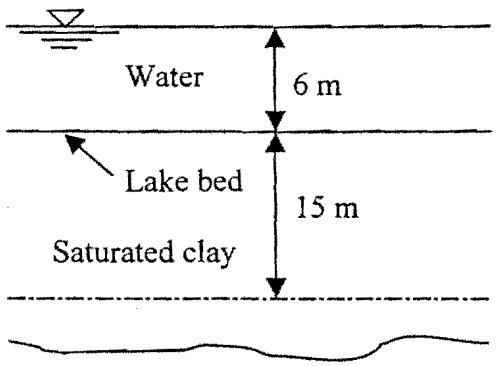

Fig. 6.1 for question no. 6 (a)

(b) For a given soil, show that $\gamma_d = \dfrac{G\gamma_w}{1 + \dfrac{wG}{S_r}}$ [7.5]

7. (a) A concentrated load of 30 kN acts on the surface of a homogeneous soil mass of large extent. Find the stress intensity: (i) at a depth of 8 m directly under the load; and (ii) at a depth of 8 m, horizontally 6 m apart from the load. [10]

(b) In order to compute the seepage loss through the foundation of a dam, flownets were constructed. The result of the flownet gave $N_f = 6$ & $N_d = 16$. The head loss during seepage was 6 m. If the co-efficient of permeability of the soil, $k = 4\times10^{-5}$ m/min., compute the seepage loss per metre length of dam per day. [7.5]

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FAKULTI KEJURUTERAAN

(Faculty of Engineering)

Kejuruteraan Tapak

(Foundation Engineering)

KNS 3243 / KNS 4243

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	13 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	9.00 am– 12.00 pm
Tempat *(Place)*	:	Dewan Kuliah I	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Prof. M. Zoynul Abedin			

Arahan *(Instruction)* :

1. **Terdapat TUJUH (7) soalan dalam kertas soalan ini. Jawab soalan nombor SATU (1) dan mana-mana EMPAT (4) soalan yang lain.**
   (There are SEVEN (7) questions in this question paper. Answer QUESTION NO. 1 and ANY OTHER FOUR (4) questions)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

*There are **SEVEN** questions. Answer **QUESTION NO. 1** and **ANY FOUR** from the rest.*
(Assume reasonable value(s) of any data, if missing. Answer should be brief and to the point. The figures in the margin indicate full marks.)

1. Answer any **10 (TEN)** of the following questions: **COMPULSORY** ***(10 X 3 = 30 marks)***

   (i) What is sub-surface investigation? What are the information required from a subsurface investigation?
   (ii) Give a list of soil samples as classified based on various criteria.
   (iii) What are the various methods of soil boring? How are the borehole sides prevented from collapsing?
   (iv) Prove that for a footing in purely cohesive soil *(ϕ=0)* the net ultimate bearing capacities for surface and shallow depth footings are equal.
   (v) Draw a neat diagram and explain the borehole sampling technique.
   (vi) Show in a line diagram various types of foundations.
   (vii) State the four stages of deformation and, various failure modes in a soil mass due to footing foundation.
   (viii) Briefly explain 'critical depth' in relation to piled foundation.
   (ix) What are the advantages of drilled pier foundation as compared to the similar class of foundations?
   (x) Write a short note on 'Steinning' of well foundation.
   (xi) What are the general criteria for the design of machine foundations?
   (xii) What is collapsible soil? What are its characteristics?
   (xiii) Explain the following terms: Ultimate bearing capacity, Allowable bearing capacity, and Negative skin friction.
   (xiv) Explain the principles of Standard Penetration Test.

2. (a) A footing, 2 m square, is founded at a depth of 1.5 m in a sand deposit for which the corrected SPT N-value is 30 (N_γ=45, N_q=30). The water table is at ground surface. Determine the net allowable bearing pressure, if the permissible settlement is 25 mm and a factor of safety of 3.0 is desired against shear failure. Assume γ_{sat}=18 kN/m^3. Use Fig. 1, if necessary. Given that: $q_{ult} = 1.3cN_c + 0.4B\gamma N_\gamma + qN_q$. ***(10 marks)***

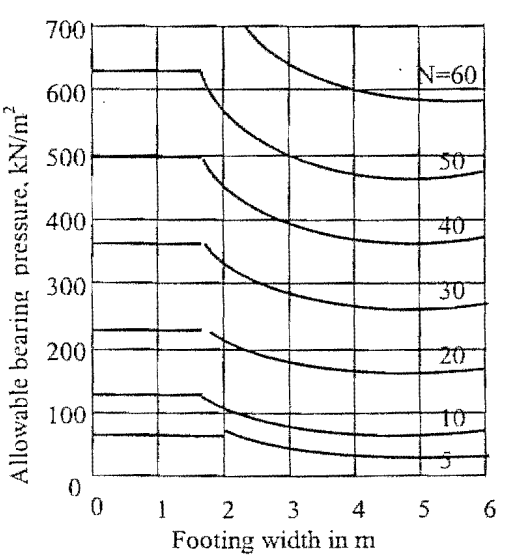


Fig. 1 for Question No. 2(a)

(b) Calculate the ultimate load per metre run that an eccentrically loaded strip footing of width 2.0 m with an eccentricity of 0.25 m can take at a depth of 1.0 m in a soil with γ=18 kN/m^3, c= 15 kN/m^2 and ϕ=30°. Use Meyerhof's formula and assume N_c=30.1, N_q=18.4 and N_γ=15.7 for ϕ=30°. *(7.5 marks)*

Given that:

$$q_{ult} = cN_c S_c d_c + \tfrac{1}{2} B\gamma N_\gamma S_\gamma d_\gamma + qN_q S_q d_q \qquad d_c = 1 + 0.2\left(\frac{D_f}{B}\right)\sqrt{K_p}$$

$$B' = B - 2e$$

$$S_c = 1 + 0.2K_p\frac{B}{L} \qquad d_\gamma = 1 + 0.1\left(\frac{D_f}{B}\right)\sqrt{K_p}$$

$$S_q = S_\gamma = 1 + 0.1K_p\frac{B}{L} \qquad K_p = \tan^2\left(45 + \frac{\varphi}{2}\right)$$

3. (a) A three-storey building is to be constructed on sand beach. Ground water rises to ground level. The beach sand has the following properties: γ= 17.5 kN/m^3, γ_{sat}= 19 kN/m^3, ϕ=32° (N_c=40, N_q=25, N_γ=30). The maximum column load will be 700 kN. Determine the sizes of square footing for depths of 1 m and 2 m using a factor of safety of 3. Settlements are not considered. Comment on the two alternatives (1 m depth and 2 m depth) foundations. *(10 marks)*

(b) A 16 pile group has to be arranged in square in soft clay with uniform spacing. Neglecting end bearing, determine the optimum value of the spacing of the piles in terms of pile diameter, assuming α=0.80. *(7.5 marks)*

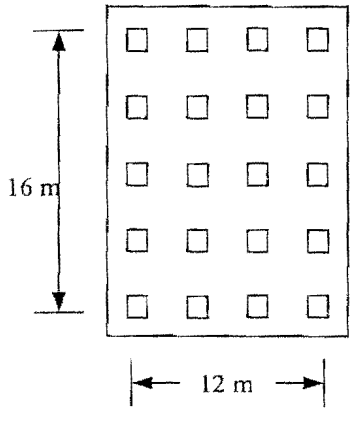
4. (a) A building plan has 4m grids of columns and the building site has the soil properties as shown in Fig. 2. Design a rigid raft foundation for the building. Each of the interior columns takes a load of 900 kN and each of the exterior columns 650 kN. Assume a factor of safety of 3.0 for bearing capacity. The allowable settlement is 125 mm. Take a vertical stress distribution factor of 0.7, 0.5 and 0.2 respectively for layers I, II and III. The soil above water table is saturated due to capillary. *(10 marks)*

Given that:

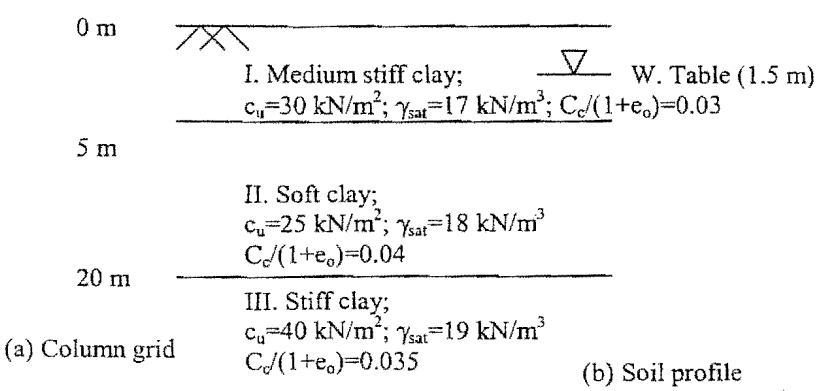
$$\rho_i = \frac{q_n B}{E}\left(1-\nu^2\right)I_p; \quad \rho_c = \sum\frac{C_c}{1+e_o}H.\log\frac{p_o+\Delta p}{p_o}; \quad E = 700\,c_u$$

Assume depth correction factor = 1.0; Rigidity correction factor = 0.80; I_p = 1.2; ν = 0.50.

No pore pressure correction is required.



(a) Column grid



(b) Soil profile

Fig.2 for Question No. 4(a)

(b) What is the safe load from a column to a rectangular footing, 1m × 2m, placed at a depth of 0.8m in saturated clay having unit weight of 20 kN/m^3 and cohesion of 100 kN/m^2? Assume a factor of safety of 2.5. Use Skempton's formula. Given that: $N_c = 5\left(1 + 0.2\frac{B}{L}\right)\left(1 + 0.2\frac{D_f}{B}\right)$. *(7.5 marks)*

5. (a) A 15 m long 350 mm square concrete pile is to be driven into a thick deposit of medium dense sand with an average SPT value of 20. The bulk and saturated unit weights of the soil are 17 kN/m^3 and 19 kN/m^3 respectively. The water table lies at 2.0 m below ground level. Estimate the pile capacity assuming that no pile load test would be done. Given that: D_c/B= 12, $K_s.\tan\delta$=0.7 and N_q=90. *(10 marks)*

(b) Determine the length of a 500 mm diameter pile to support a working load of 600 kN at a site where two layers of clay exist. The upper layer is 8 m thick with an undrained strength of 80 kN/m^2. The lower layer extends to great depth having undrained strength of 120 kN/m^2. Assume that the top 1 m of the pile does not support any load due to clay concrete shrinkage. Assume α as 0.55 and 0.45 respectively for top and bottom layers. Use FS= 3.0. *(7.5 marks)*

6. (a) An office building is to be supported on a series of 800 mm diameter, 20.0 m long drilled shafts that will be built using the open hole method. The soil profile at this site is as follows:

Depth (m)	Soil Type	Undrained shear strength, c_u (kN/m^2)
0 – 20.0	Stiff clayey silt (CL)	80
20.0 – 30.0	Stiff silty clay (CL)	120

The shaft has a bell 2.0 m base with 2.0 m height. The ground water table is at a depth of 30 m, the degree of control is normal and the design life is 50 years. Calculate the allowable downward capacity of each shaft using Reese and O'Neill method. Assume α=0.55 and FS=2.5. *(10 marks)*

Given that:

$$N_c = 6\left[1 + 0.2\left(\frac{D_f}{B_b}\right)\right] \le 9; \quad q'_e = N_c c_u \le 4000\,kPa; \quad q'_{er} = F_r q'_e;$$

$$F_r = \frac{2.5}{120\Psi_1(B_b / B_r) + \Psi_2} \le 1.0; \quad \Psi_1 = 0.0071 + 0.0021(D_f / B) \le 0.015;$$

$$\Psi_2 = 1.59\sqrt{\frac{c_u}{\sigma_r}} \quad 0.5 \le \Psi_2 \le 1.5; \quad \sigma_r = 100\,kPa; B_r = 0.30\,m.$$

(b) An open caisson 20 m deep is of cylindrical shape with external and internal diameters of 9 m and 6 m respectively. If the water level is 2 m below the top of the caisson, determine the minimum thickness of the seal required. Check for perimeter shear also. Assume σ_c= 2400 kN/m^2 and γ_c=24 kN/m^3 for concrete. Allowable perimeter shear stress = 650 kN/m^2. *(7.5 marks)*

Given that: $q = (\gamma_w H - \gamma_c t)$; $t = 0.59 D_i \sqrt{\frac{q}{\sigma_c}}$; $F_w = 0.25 \gamma_w \pi D_i^2 (H - t)$

7. (a) A 50 kN load is to be applied to a 1 m square, 0.5 m deep footing that will be supported on a collapsible soil. The soil extends to a depth of 2.5 m below the ground surface and has a unit weight of 17 kN/m^3. At 50% saturation, it has a unit weight of 18.5 kN/m^3. The value of α is given by α = (0.9-0.1z). Where z is the depth in metre. Calculate the settlement of the footing due to hydro-consolidation. Assume C_w= 0.080. Consider two finite layers. Given that:

$$\delta_w = \sum \alpha C_w H_i \log\left(\frac{\sigma_v}{\sigma_t}\right); \quad \sigma_v = \left(\frac{1.7P}{(B + z_f)(L + z_f)}\right) - 0.05q; \quad \sigma_t = 10\ kPa.$$

(10 marks)

(b) A 30 kN vertical compressor foundation system is operated at 40 Hz. The foundation soil is medium stiff clay having co-efficient of elastic uniform compression = 40000 kN/m^3. Determine the natural frequency and the magnification factor. Assume the weight of foundation to be 0.25 times the weight of the machine. The base area of the foundation is 3 m^2. Take damping factor, D=ϵ=0. *(7.5 marks)*

Given that: $\omega_n = \sqrt{\frac{c_u . A}{m}}$; $f_n = \frac{\omega_n}{2\pi}$; $M = \frac{1}{\sqrt{4D^2 r^2 + (1 - r^2)^2}}$; $r = \frac{f}{f_n}$

----- GOOD LUCK -----

FAKULTI KEJURUTERAAN

SET-SET SOALAN
KEJURUTERAAN MEKANIKAL
& SISTEM PEMBUATAN

25 OKTOBER 2004

UNIVERSITI MALAYSIA SARAWAK

94300 KOTA SAMARAHAN
SARAWAK

FAKULTI KEJURUTERAAN

(Faculty of Engineering)

Tenaga Pembuatan

(Energy for Manufacturing)

KNP 3043

Peperiksaan *(Examination)*	:	Final	**Tarikh** *(Date)*	:	13 October 2004
Semester	:	1 Session 2004/2005	**Masa** *(Time)*	:	9.00 AM – 12.00 PM
Tempat *(Place)*	:	Seminar Room 23	**Jangkamasa** *(Duration)*	:	3 hours
Pensyarah *(Lecturer)*	:	Dr. Mohammad Omar Abdullah			

Arahan *(Instruction)* :

1. **Jawab semua soalan.**
   (Answer all questions)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Serahkan kertas jawapan berasingan untuk kedua-dua seksyen tersebut.**
   (Submit the answer scripts separately for both sections)
5. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
6. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

Part 1 (total marks for this section: 30 %)

Instruction: Read the following questions (Question 1-10) carefully. Write your answer in the answer sheet provided. Each question carries 3 marks. Note that all questions in this section are multiple choices except Question 2 and 3.

Question no 1.

Which of the following statement (s) is (are) true in relation to the use of solar energy?

I. Solar power pays off in remote places as a supplement to diesel power that can cost $US0.6 to $US2/kWh.

II. Solar cells produce virtually no power when sunlight is intercepted by clouds even thought the sky is bright.

III. Sunlight has low energy density, around 70 mW/cm2. Therefore, a concentrator oriented towards the sun is needed if high temperatures are to be used for driving a steam engine.

A) I

B) I and II

C) I, II and III

D) III only

E) None of the above

Question No. 2

"In a fuel cell, energy conversion occurs by an electrochemical processes that is the reverse of electrolysis". State whether the statement above is true or false. If so, state your reason why.

Question No. 3

"The diesel engine differs from the gasoline engine mainly in the mechanism of expansion'. State whether the statement above is true or false. If so, state your reason why.

Question No. 4

Which one of the following is *correct* about the nuclear energy for power generation through the use of steam turbine?

A) In a nuclear power plant, the reactor and heat exchanger take the place of the conventional boiler, and the steam generated is then expanded through a conventional turbine.

B) Public opinion has favored the nuclear power because there are increasing environmental worries over the use of fossil fuels (e.g. the greenhouse effect, acid rain, etc.).

C) The nuclear fuel contributing around 17% in the Europe as electricity generating source. A rapid increase in the use of this energy source was noted in steam turbine power stations.

D) The pressurized water reactors (PWR) was introduced in the 1950s while the Magnox gas-cooled reactors were introduce around 1980s.

E) All the statements A through D above are not true.

Question No. 5

Which of the following about the use of wind for energy generation are true?

I. Generally, small wind generators use upwind, horizontal-axis turbine while large generators often use the down-wind turbine type.

II The cost of wind power depends on the cost of the turbine and the average wind energy available at the site. Power from a site with 240 watts/m^2 average will cost twice as much as power from a 480 watts/m^2 site.

III. The main advantage of the vertical-axis machine is that it does not have to yaw or turn while changing wind direction.

A) I

B) I and II

C) I, II and III

D) III only

E) None of the above

Question No. 6

Which one of the following is *correct* about the water energy for power generation?

I) Water is collected and stored at a high elevation and led through penstocks or pipelines to the hydraulic power station.

II) The Kaplan turbine is of the impulse turbine type, and is operating for heads up to 90-900meter.

III) Maximum efficiencies of hydraulic turbines are between 35 - 40 percent.

IV) Since the potential energy can be calculated by the potential energy equation, for a flow rate of 1 m^3/sec with a head of 100 meter, the system will have a hydraulic power of around 9.8 x 10^5 Watt.

A) I

B) I and II

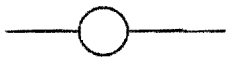
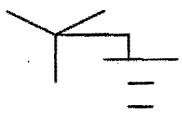
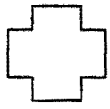
C) I, II and III

D) I and IV

E) None of the above

Question No. 7

Which one of the following symbols is correctly represented in an electric energy system?

A) 	Oil circuit breaker
B) 	Delta connection
C) 	Grounded wye-connection
D) 	Generator/motor
E) 	Two-winding transformer

Question No. 8

Power generating system must have a provision for energy storage. Which one of the following is *not* an energy storage method?

A) storage batteries.
B) power transformer
C) superconducting coils
D) hydrogen gas
E) compressed air

Question No. 9

Although alternative methods of power generation and heat supply are attractive in principle, and it is essential to know what they can offer as part of energy policy development, there are good reasons for supporting existing methods of energy supply based on fossil and nuclear fuels due to the following reasons:

I) the resources are known to a reliable extend.
II) the technology is established and the economics are understood i.e. the cost-demand balance and labor needs are known.
III) the energy density of the fossil fuels are high

A) I
B) I and II
C) I, II and III
D) I and IV
E) None of the above

Question No. 10

Which one of the following is *not* true?

A) The power plant energy distribution can be shown diagrammatically by a Sankey Diagram.

B) Pinch technology or process integration is a graphical method that can be used to optimize heat recovery in large complex plants.

C) Increasing efficiency by raising steam pressure and temperature are likely to be very expensive in term of capital investment while the amount of efficiency improvement is small.

D) The energy audit is a formal account of the energy consumption and costs of a building/company/product over a period of time.

E) None of the above

PART II [total marks for this section: 30%]

Instruction: Read the following questions ***(Question 11 - 13)*** *carefully. Write your answer in the answer sheet provided.*

Question No. 11

An electrical energy system consists of many components.

(a) List two functions of a power generator **[4 marks]**

(b) What is a *circuit breaker* and describe briefly its working principle **[4 marks]**

Question No. 12

With the aid of a simple diagram, explain how a compressed-air storage system stores energy. **[8 marks]**

Question No. 13

(a) With the aid of a diagram, explain how an *open-cycle gas-steam* combined power plant could be used for heat and energy recovery. **[10 marks]**

(b) Briefly discussed the disadvantages of this combined cycle **[4 marks]**

Part III [total marks for this section: 40%].

Question No. 14

A particular manufacturing process requires air at 40°C at a flow rate of 0.5 kg/s from an inlet air with temperature of 15°C. The air leaving the process at 35°C. Currently the air is heated by an electric heater. The Management proposed to replace the electric heater with a heat pump system linking the inlet and exit air streams. The mass flow rate of refrigerant in the heat pump is 0.0798 kg/s and that the compressor work is 11.25kJ/kg.

(a) Calculate the heat energy (in kW) from the electric heater required to heat the air. **[4 marks]**

(b) Calculate the electric power input needed to power the heat pump. **[4 marks]**

(c) Hence, evaluate the percentage of energy saving for the running cost by using the heat pump. **[4 marks]**

(d) Sketch a temperature(T-s) diagram for the heat pump. **[4 marks]**

(e) From the T-s diagram in (d) above, calculate the heat required to evaporate the refrigerant in the heat pump. **[4 marks]**

Data: specific heat capacity = 1.005 kJ/kg.K

h_g at 25°C = 309.03 kJ/kg.K

h_f at 45°C = 162.93 kJ/kg.K

Question No. 15

A small smoked fish factory has a maximum demand of 90kW of power and 240 kW of heat for fish drying and hot water. It is decided to use six micro-CHP units running on natural gas, each developing 15 kW of power and each with a heat output of 40kW. The jacket and oil cooling system provide thermal energy equivalent to 10% of the fuel energy input, and the exhaust cooler provides thermal energy equivalent to 55% of the fuel energy input. Water enters each engine at 30°C and leaves at 85°C.

(a) Draw a typical micro-CHP system (only considering a unit of micro-CHP in your drawing). Also, indicate the temperatures on your diagram. **[4 marks]**

(b) Calculate the rate of volume flow of natural gas used **[4 marks]**

(c) Determine the total efficiency and *drying* efficiency of the system. **[4 marks]**

(d) Determine the percentage of energy saving. **[4 marks]**

(e) Determine the specific heat capacity of water (in kJ/kg K) if the mass flow rate of water used is measured to be 1.041 kg/s. **[4 marks]**

Data: taking the calorific value of natural gas as 38.5 MJ/m^3.

UNIVERSITI MALAYSIA SARAWAK

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SARAWAK

FAKULTI KEJURUTERAAN

(Faculty of Engineering)

Sistem Pembuatan

(Manufacturing Systems)

KNP 3053

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	13 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	9.00 am – 12.00 pm
Tempat *(Place)*	:	Bilik Seminar 23	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Pn. Magdalene Andrew Munot			

Arahan *(Instruction)* :

1. **Jawab semua soalan dari Seksyen A & C dan DUA (2) soalan dari Seksyen B.**
   (Answer ALL questions from Section A & C and TWO (2) question from Section B)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa pc periksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

SECTION A [10 Marks]

ANSWER ALL QUESTIONS

Each correct answer carries one (1) mark

1. Which of the following statements about aggregate planning is best?.
   a. A production plan generally focuses on production rates and inventory holdings, whereas a staffing plan focuses on staffing and other labour related factors.
   b. Reactive alternatives are actions that adjust demand patterns.
   c. Operations and marketing are the only two functional areas that supply inputs for developing production and staffing plans.
   d. A level strategy stabilizes inventory levels by adjusting production rates or staff levels to match demand levels over the planning horizon.

2. A TV repair service company has a seasonal demand for its service, and there is a general shortage of skilled TV repair persons. Which one of the following is a REACTIVE production planning alternative suitable for this situation?
   a. Hire and lay off workers to match the demand requirements.
   b. Increase the backlog for short term demand surges.
   c. Offer reduced prices during then slack season.
   d. Build anticipation inventories.

3. The available to promise quantity for any period *t* that has an MPS quantity, other than the first period, is equal to the MPS quantity in period *t*, minus:
   a. The projected on hand inventory in period *t*.
   b. The cumulative total of forecasts from period *t* up to the period that has the next MPS quantity.
   c. The cumulative total of booked customer orders from period *t* up to the period that has the next MPS quantity.
   d. The sum of the forecast and booked customer orders for period *t*.

4. Which of the following statements about MRP is TRUE?
   a. To be classified as a successful MRP user, a company must use either the L4L or POQ rules for lot sizing.
   b. MRP gross requirements for a parent item are equal to the planned order releases of its components.
   c. MRP logic is based on the logic of uniform, continuous demand, and item independence.
   d. MRP gross requirements for a component depend on the planned order releases of its immediate parents.

5. Which one of the following reasons creates a pressure for reducing inventories?.
   a. High interest or opportunity cost.
   b. On time delivery requests from customers.
   c. Need for better labour or equipment utilization.
   d. Need for reduction in total payments to suppliers.

6. Which one of the following statements concerning the economic order quantity (EOQ) is TRUE?.
   a. The EOQ is the order quantity that minimizes annual inventory holding costs.
   b. An increase in demand will increase the EOQ value.
   c. The time between orders (TBO) will increase with an increase in holding costs.
   d. The EOQ formula assumes that there are only three relevant costs: holding, transportation and setup.

7. Lean systems try to:
   a. Produce product in anticipation of demand.
   b. Maximize the value added by of each of their activities.
   c. Organize production in large lots to minimize the number of setups.
   d. Reduce the labor content in all processes.

8. A Kanban system is an important mechanism for JIT management. Which one of the following statements regarding the operation of a Kanban system is TRUE?.

   a. A typical Kanban used in the JIT system includes information such as item number, unit price, competitor's product name and its price.
   b. A Kanban can be used to set the order quantity but not the inventory level.
   c. A Kanban and a container move as a pair once production begins at the fabrication process.
   d. An empty container can be exchanged for a full container at the storage location even though no kanban is on the full container.

9. The following are material handling equipments EXCEPT:

   a. Transport equipment.
   b. Storage system.
   c. Unitizing equipment.
   d. Inspection system.

10. In designing material handling system, one must consider all of the following EXCEPT:

   a. Plant layout.
   b. Material characteristics.
   c. Worker skill.
   d. Routing of materials.

SECTION B [40 Marks]

ANSWER **ANY TWO** QUESTIONS

Question 1 [20 marks]

a. Describe the underlying principles of the Toyota production?. **[8 marks]**

b. Name four (4) different kanban systems. **[4 marks]**

c. Describe the difference between the "push" and "pull" methods of material flow?. Which does JIT use?. **[8 marks]**

Question 2 [20 marks]

a. Define material handling. **[2 marks]**

b. Discuss three (3) principles of material handling. **[9 marks]**

c. "Automated material handling systems are the solution to all material handling problems". Give and discuss three (3) reasons, whether you agree or disagree with this statement. **[9 marks]**

Question 3 [20 marks]

a. Discuss the effects of product design time on manufacturer's competitiveness. **[5 marks]**

b. Discuss the relationship between employee's participation program and productivity improvement. **[5 marks]**

c. Discuss the relationship between workers' safety and low cost production. **[5 marks]**

d. Discuss the effects of supplier's partnership program on delivery as promised. **[5 marks]**

SECTION C [50 Marks]

Flashy Flasher Sdn. Bhd, is a medium-sized firm employing 500 persons and 75 managerial and administrative personnel. It operates 50 weeks per year. The firm produces a line of automotive electrical components. It supplies about 75 auto-parts stores and car dealers in Sarawak. The company's most profitable product is the head lamp. With the recent boom in the auto industry and the rising popularity of Multi Purpose Vehicle (MPV), Flashy Flasher Sdn Bhd. has enjoyed substantial demand for this head lamp.

The head lamp (HL) is made of items A1(4), A2(2) and A3(1). Item A2 is further assembled from items A1(2), B1(1), B2(2), B3(1). The number in the bracket shows the usage quantities. Item A1 (screws) are purchased from another company (Skru Sdn. Bhd.) located in Miri. The cost to place an order for screws to Skru Sdn. Bhd is Rm25 and the annual holding cost to hold a screw in stock is Rm2. The item numbers and description for the head lamp is shown in Table 1.

Demand and capacity data (in hundreds of product units, 000) for the head lamp for the next four period is shown in Table 2. Undertime is unpaid, and no cost is associated with unused overtime or subcontractor capacity. Producing one unit of head lamp on regular time costs Rm100, including Rm50 for labour. Producing a unit of head lamp on overtime costs Rm150. A subcontractor can produce a unit to Flashy Flasher Sdn Bhd. specifications for Rm180. Holding a head lamp in stock cost Rm50 for each quarter period and 50 head lamps are currently in stock. The plan calls 450 units to be in stock at the end of quarter 4. Overtime production must utilize its maximum capacity. The quantities of head lamp for subcontract work must be 300 units. No backorder or stockouts are allowed.

Forecast breakdown for January and February starting from week 1 to week 8 are 45, 150, 170, 120, 80, 120, 180 and 135. The booked customer orders for this head lamp (HL), starting in week 1 are, 40, 90, 110, 50, 20, 60, 110 and 0. The current on hand inventory is 50 head lamps, the order quantity is 250 units and the lead time is 1 week. Table 3 shows the inventory record data for components A1, A2, A3, B1, B2 and B3.

Table 1: Part numbers and description	
Part Numbers	**Description**
HL	Head lamp
A1	Screw
A2	Head frame subassembly
A3	Head lens
B1	Head lamp module
B2	Back rubber gasket
B3	Head frame

Table 2: Demand and Capacity data (in hundreds of product units)				
	Quarter			
	1 (Jan – Mar)	**2 (Apr.- June)**	**3 (July – Sept.)**	**4 (Oct – Dec)**
Forecast	1000	1100	1900	1000
Capacities				
Regular time	850	850	950	850
Overtime	170	170	190	170
Subcontractor	300	300	300	300

Table 3: Data from inventory record					
Part number	**Lead time (weeks)**	**Safety stock (units)**	**Lot sizing rule**	**Quantity on hand**	**Scheduled Receipt (units and due dates)**
A1	1	30	FOQ = 250	150	-
B1	1	20	FOQ = 180	30	180 (wk 4)
A2	2	0	L4L	100	100 (wk 4)
A3	2	15	FOQ = 350	15	-
B2	3	100	POQ (P = 3 wks)	500	1100 (wk 2)
B3	1	0		70	-

ANSWER ALL QUESTIONS

Q1 Draw the Bill of Materials (BOM) for item HL (head lamp). Calculate the amount of item A1 (screws) needed for producing 5000 units of item HL (head lamp). **[5 marks]**

Q2 Prepare a production plan for item HL (head lamp) using the transportation method of production planning. Calculate the total cost of this production plan. **[9 marks]**

Q3 Develop a master production schedule (MPS) for item HL (head lamp). If in week 1, a customer requests a new order for 30 units of item HL (head lamp), when is the earliest due date the entire order could be shipped?. **[13 marks]**

Q4 Develop a material requirements plan for the next eight weeks for item A2 (head frame subassembly) and B2 (back rubber gasket). What action notices will be issued for both MPS?. **[17 marks]**

Q5 Calculate the Economic Order Quantity (EOQ), ordering cost and holding cost for item A1 (screws). **[6 marks]**

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FAKULTI KEJURUTERAAN
(Faculty of Engineering)

Sistem Pembuatan Lanjutan
(Advance Manufacturing Systems)

KNP 4073

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	21 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	9.00 am – 12.00 pm
Tempat *(Place)*	:	Bilik Seminar 23	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	En. Abdullah Hj. Yassin			

Arahan *(Instruction)* :

1. **Jawab semua soalan.**
   (Answer all questions)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

INSTRUCTION: ANSWER FOUR (4) QUESTIONS ONLY.

QUESTION 1:

a) Describe what is meant by the term Concurrent Engineering and list the benefits that can be achieved by following this philosophy. **[6 marks]**

b) Describe what is meant by "Over the wall engineering approach" and discuss the problems involved in this approach. **[14 marks]**

QUESTION 2:

a) What is Rapid Prototyping? Explain the steps that involved in the Rapid Prototyping cycle. **[16 marks]**

b) Why are cleaning and finishing operations necessary for rapid prototyping processes? **[4 marks]**

QUESTION 3: Process planning is a critical function that impinges on design and manufacture.

a) Describe what is meant by Process planning? **[4 marks]**

b) Describe the steps that involved in Process Planning? **[6 marks]**

c) Describe the two main types of CAPP system that are available and discuss their advantages. **[10 marks]**

QUESTION 4:

a) Apply the rank order clustering technique to the part-machine incidence matrix in the following table to identify logical part families and machine groups. Parts are identified by letters and machines are identified numerically.

	Parts								
Machines	A	B	C	D	E	F	G	H	I
1	1								1
2		1					1		
3			1		1			1	
4		1				1	1		
5			1					1	
6						1	1		
7	1			1					
8			1		1				

[7 marks]

b) The required production rate = 50 units per hour for a certain product whose assembly work content time = 1.2 hours of direct manual labor. It is to be produced on a production line that includes four workstations that are automated. Because the automated stations are not completely reliable, the line will have an expected uptime efficiency = 90 %. The remaining manual stations will have one worker each. It is anticipated that 8% of the cycle time will be lost due to repositioning at the bottleneck station. If the balance delay is expected to be d = 0.07, determine:

i. The cycle time
ii. Number of workers
iii. Number of workstations needed for the line
iv. Average manning level on the line, including the automated stations
v. Labor efficiency on the line.

[7 marks]

c) Manufacturing cells can be classified into four categories. Explain briefly.

[6 marks]

QUESTION 5:

A new small electrical appliance is to be assembled on a single model assembly line. The line will be operated 250 days per year, 15 hours per day. The work content has been divided into work elements as defined in the table below. Also given are the element times and precedence requirements. Annual production is to be 200,000 units. It is anticipated that the line efficiency (proportion uptime) E = 0.96. The repositioning time for each worker is 0.08 min. Determine:

(a) Average hourly production rate

(b) Cycle time

(c) Theoretical minimum number of workers required to meet annual production requirements.

(d) Use Ranked Positional Weight method to balance the line. For your solution, determine:
   i. Balance efficiency
   ii. Overall labor efficiency on the line.

[20 marks]

Element No.	Element description	T_e (min.)	Preceded by
1	Place frame on workholder and clamp	0.15	-
2	Assemble fan to motor	0.37	-
3	Assemble bracket A to frame	0.21	1
4	Assemble bracket B to frame	0.21	1
5	Assemble motor to frame	0.58	1, 2
6	Affix insulation to bracket A	0.12	3
7	Assemble angle plate to bracket A	0.29	3
8	Affix insulation to bracket B	0.12	4
9	Attach link bar to motor and bracket B	0.30	4, 5
10	Assemble three wires to motor	0.45	5
11	Assemble nameplate to housing	0.18	-
12	Assemble light fixture to housing	0.20	11
13	Assemble blade mechanism to frame	0.65	6, 7, 8, 9
14	Wire switch, motor, and light	0.72	10, 12
15	Wire blade mechanism to switch	0.25	13
16	Attach housing over motor	0.35	14
17	Test blade mechanism, light, etc.	0.16	15, 16
18	Affix instruction label to cover plate	0.12	-
19	Assemble grommet to power cord	0.10	-
20	Assemble cord and grommet to cover plate	0.23	18. 19
21	Assemble power cord leads to switch	0.40	17, 20
22	Assemble cover plate to frame	0.33	21
23	Final inspect and remove from workholder	0.25	22
24	Package	1.75	23

FORMULA

$$R_p = \frac{D_a}{50SH} \qquad T_c = \frac{60E}{R_p} \qquad R_c = \frac{60}{T_c} \qquad E = \frac{R_p}{R_c} \qquad w = \frac{WL}{AT}$$

$$WL = R_p T_{wc} \qquad WL = \frac{60ET_{wc}}{T_c} \qquad AT = 60E$$

$$w^* = \text{Minimum Integer} \geq \frac{T_{wc}}{T_c} \qquad \text{Max}\{T_{si}\} \leq T_c - T_r \quad \text{for } i = 1, 2, \ldots, n$$

$$T_s = \text{Max}\{T_{si}\} \leq T_c - T_r \qquad E_r = \frac{T_s}{T_c} = \frac{T_c - T_r}{T_c} \qquad T_{si} = \sum_{k \in i} T_{ek}$$

$$T_{wc} = \sum_{i=1}^{n} T_{si} \qquad E_b = \frac{T_{wc}}{wT_s} \qquad d = \frac{(wT_s - T_{wc})}{wT_s}$$

$$w = \text{Minimum Integer} \geq \frac{R_p T_{wc}}{60EE_rE_b} = \frac{T_{wc}}{E_rE_bT_c} = \frac{T_{wc}}{E_bT_s}$$

$$n = \frac{w}{M} \qquad L = \sum_{i=1}^{n} L_{si} \qquad L = nL_s \qquad f_p = \frac{1}{T_c}$$

$$s_p = \frac{v_c}{f_p} = v_c T_c \qquad T_t = \frac{L_s}{v_c} \qquad ET = \frac{L}{v_c} = nT_t$$

$$\text{Minimize } (wT_s - T_{wc}) \text{ or Minimize } \sum_{i=1}^{w} (T_s - T_{si})$$

$$m_i q_i + (1 - m_i)q_i + (1 - q_i) = 1 \qquad mq + (1 - m)q + (1 - q) = 1$$

$$\prod_{i=1}^{n} [m_i q_i + (1 - m_i)q_i + (1 - q_i)] = 1 \qquad [mq + (1 - m)q + (1 - q)]^n = 1$$

$$P_{ap} = \prod_{i=1}^{n} (1 - q_i + m_i q_i) \qquad P_{qp} = 1 - P_{ap} = 1 - \prod_{i=1}^{n} (1 - q_i + m_i q_i)$$

$$P_{ap} = (1 - q + mq)^n$$

$$P_{qp} = 1 - (1 - q + mq)^n$$

$$F = \sum_{i=1}^{n} p_i = \sum_{i=1}^{n} m_i q_i$$

$$F = nmq$$

$$T_p = T_c + \sum_{i=1}^{n} m_i q_i T_d$$

$$T_p = T_c + nmqT_d$$

$$R_p = \frac{1}{T_p}$$

$$R_{ap} = P_{ap} R_p = \frac{P_{ap}}{T_p} = \frac{\prod_{i=1}^{n}(1 - q_i + m_i q_i)}{T_p}$$

$$R_{ap} = P_{ap} R_p = \frac{P_{ap}}{T_p} = \frac{(1 - q + mq)^n}{T_p}$$

$$E = \frac{R_p}{R_c} = \frac{T_c}{T_p}$$

$$C_{pc} = \frac{C_m + C_o T_p + C_t}{P_{ap}}$$

$$T_c = T_h + \sum_{j=1}^{n_e} T_{ej}$$

$$T_p = T_c + \sum_{j=1}^{n_e} q_j m_j T_d$$

$$T_p = T_c + nmqT_d$$

$$T_p = T_c + \sum_{i \in n_a} p_i T_d$$

$$p_i = m_i q_i$$

$$T_p = T_c + n_a p T_d$$

$$C_o = C_{at} + \sum_{i \in n_a} C_{asi} + \sum_{t \in n_w} C_{wi}$$

$$C_o = C_{at} + n_a C_{as} + n_w C_w$$

$$C_{pc} = \frac{C_m + C_o T_p + C_t}{P_{ap}}$$

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FAKULTI KEJURUTERAAN
(Faculty of Engineering)

TERMODINAMIK 1
(Thermodynamics 1)

KNJ1033

Peperiksaan *(Examination)*	:	AKHIR	**Tarikh** *(Date)*	:	21 OKTOBER 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	2.00 p.m – 4.30 p.m
Tempat *(Place)*	:	**Bilik Seminar 23**	**Jangkamasa** *(Duration)*	:	$2^{1/2}$ jam
Pensyarah *(Lecturer)*	:	Pn. Shanti Faridah Salleh			

Arahan *(Instruction)* :

1. **Jawab TIGA soalan (Bahagian A) dan Jawab SATU soalan sahaja (Bahagian B).**
   (Answer THREE questions from Section A and ONE question only from Section B)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

SECTION A (75%)
(Answer THREE questions in this section)

QUESTION 1

(a) What is a throtting valve? Name two devices that apply the concept of throttling valve. Derive an open steady state system from First Law of Thermodynamics for throttling valve. **[10 marks]**

(b) Why are throttling devices commonly used in refrigeration and air conditioining applications? **[5 marks]**

(c) During a throttling process, the temperature of a fluid drops from 30 to $-20^{\circ}C$. Can this process occur adiabatically? Why? **[5 marks]**

(d) Would you expect the temperature of a liquid to change as it throttled? Explain. **[5 marks]**

QUESTION 2

Consider a 1000-W iron whose base plate is made of 0.5 cm thick aluminium alloy 2024-T6 ($\rho = 2270\ kg/m^3$ and $C_p = 875\ J/kg^{\circ}C$) The base plate has a surface area of $0.03\ m^2$. Initially, the iron is in thermal equilibrium with the ambient air at $22^{\circ}C$. Assuming 85% of the heat generated in the resistance wires is transferred to the plate, determine the minimum time needed for the plate temperature to reach $140^{\circ}C$. **[25 marks]**

QUESTION 3

(a) What are the two statements known as the Carnot Principles? **[6 marks]**

(b) Somebody claims to have developed a new reversible heat-engine cycle that has a higher thereotical efficiency than the Carnot cycle operating between the same temperature limits. How do you evaluate this claim? **[6 marks]**

(c) In tropical climates, Figure 3, the water near the surface of the ocean remains warm throughout the year as a result of solar energy absorption. In the deeper parts of the ocean, however, the water remains at a relatively low temperature since the sun's rays cannot penetrate very far. It is proposed to take advantage of this temperature difference and construct a power plant that will absorb heat from the warm water near the surface and reject the waste heat to the cold water a few hundred meters below. Determine the maximum thermal efficiency of such a plant if the water temperatures at the two respective locations are $24^{\circ}C$ and $3^{\circ}C$. **[13 marks]**

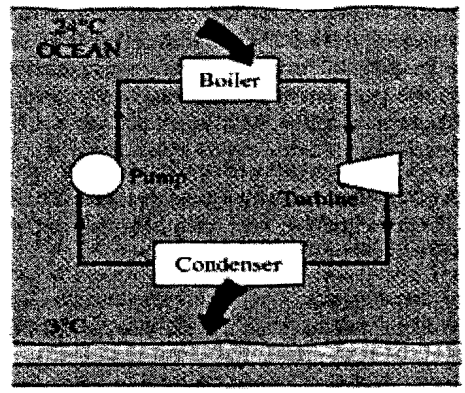

Figure 3

QUESTION 4

The drinking water need of a production facility with 20 employees is to be met by a refrigerated water fountain. The refrigerated water fountain is to cool warm water from 22°C to 8°C and supply cold water at a rate of 0.4L per hour per person. Heat is transferred to the reservoir from the surroundings at 25°C at a rate of 45W. If the COP of the refrigeration system is 2.9, determine the size of the compressor, in Watt (W), that will be suitable for this cooler. **[25 marks]**

SECTION B (25%)
(Answer ONE question in this section)

QUESTION 5

(a) Is a process during which no entropy is generated $S_{gen} = 0$, necessarily reversible? **[2 marks]**

(b) A piston cylinder device initially contains 2L of air at 100kPa and 25°C. Air is now compressed to a final state of 600kPa and 150°C. The useful work input is 1.2 kJ. Assuming the surroundings are 100kPa and 25°C, determine

(i) the exergy of the air at the initial and final states? **[16 marks]**

(ii) The minimum work that must be supplied to accomplish this compression process. **[4 marks]**

(iii) The second law efficiency of this process. **[3 marks]**

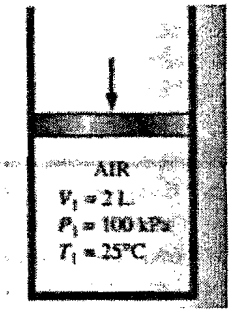

Figure 5

QUESTION 6

A 0.3m^3 rigid tank is filled with saturated liquid water at 200°C. A valve at the bottom of the tank is opened, and liquid is withdrawn from the tank. Heat is transferred to the water such that the temperature in the tanks remains constant. Determine the amount of heat that must be transferred by the time one-half of the total mass has been withdrawn.

[25 marks]

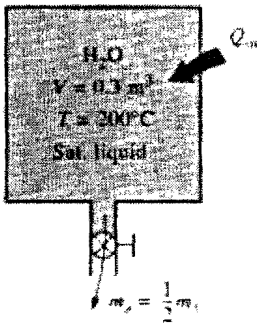

Figure 6

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FAKULTI KEJURUTERAAN

(Faculty of Engineering)

Termodinamik II

(Thermodynamics II)

KNJ 2094 / 2093

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	19 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	9.00 am – 12.00 pm
Tempat *(Place)*	:	Bilik Seminar 12	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Dr. Mohammad Omar Abdullah			

Arahan *(Instruction)* :

1. **Jawab semua soalan.**
   (Answer all questions)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Serahkan kertas jawapan berasingan untuk kedua-dua sekyen tersebut.**
   (Submit the answer scripts separately for both sections)
   Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

Instruction: Answer all questions. Each question carries equal marks.
If the thermodynamics data you required were not specifically given in the question, you may consult the Thermodynamics Properties Data Table (Steam Table) provided.

Question 1.

(a) Sketch a reciprocating piston-cylinder IC engine and label the important parts. **[3 marks]**
(b) Construct an actual Pressure-volume diagram showing all the processes involved in the strokes. **[3 marks]**
(c) Consider an air standard Otto Cycle where the maximum and minimum temperatures are 1400 and 15°C. The heat supplied per kg of air is 800kJ.
i) Draw the pressure-volume and T-s diagram of the Otto cycle. **[4 marks]**
ii) Calculate the compression ratio and **[5 marks]**
iii) Determine the cycle efficiency. **[5 marks]**

Data: take the c_p, c_v and γ of air as 1.005kJ/kg.K, 0.718 kJ/kg.K and 1.4 respectively

Question 2.

A single-stage, single acting air compressor (Fig. 1) running at 1000 RPM delivers air at 25 bar. For this purpose the induction and free air conditions can be taken as 1.013 bar and 15°C, and the FAD as 0.25m3/min. The clearance volume is 3% of the swept volume and the stroke/bore ratio is 1.2/1.
(a) State the function of *water jacket* and the *clearance volume* **[1 mark]**
(b) Construct the pressure-volume diagram of the compressor **[1 mark]**
(c) Calculate the bore and stroke; **[5 marks]**
(d) Determine the volumetric efficiency; **[3 marks]**
(e) Calculate the indicated power input **[5 marks]**
(f) Calculate isothermal efficiency. **[5 marks]**
Data: Take the index of compression and re-expansion as 1.3.

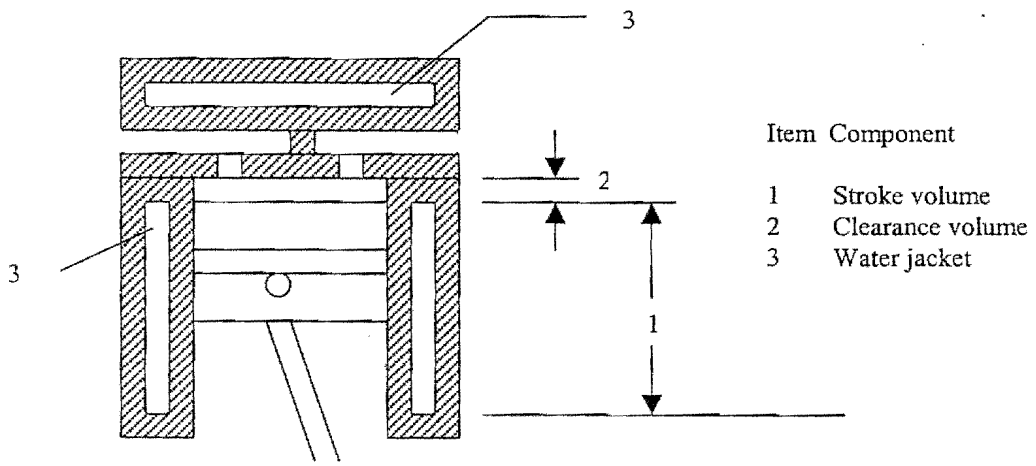

Fig. 1 Schematic diagram of a Single-stage, single acting compressor

Question 3.

Steam is supplied to a two-stage turbine at 40 bar and 500°C. In the first stage, the steam is expands isentropically to 3.0 bar at which pressure 2500 kg/h of steam is extracted for process work. The remainder is reheated to 500°C and then expanded isentropically to 0.06 bar. The by-product power from the plant is required to be 6000 kW.

(a) Construct a temperature-entropy diagram to illustrate the operating states; **[4 marks]**
(b) Calculate the mass flow rate of the boiler steam required (in kg/hour); **[8 marks]**
(c) Calculate the total heat supplied required from the boiler and the reheater **[8 marks]**

Question 4.

A local industrial company is considering of choosing two types of refrigerants for their refrigeration plant.

(a) The vapour leaves the evaporator dry saturated at 1.826 bar and is compressed to 7.449 bar. The temperature of the vapour leaving the compressor is 45°C. The liquid leaves the condenser at 25°C and is throttled to the evaporator pressure. Sketch a temperature-entropy diagram for the refrigerating processes. **[1 mark]**
(b) Using *R12* , calculate:
  (i) the refrigerating effect; **[3 marks]**
  (ii) the specific work input; **[3 marks]**
  (iii) the coefficient of performance (COP) **[3 marks]**
(c) Repeat the calculations of (b) above using *R134a.* **[9 marks]**
(d) What type of refrigerant should be used if the higher COP is desired for the plant (ignoring any cost or environmental considerations). **[1 mark]**

Question 5.

A gas turbine has an overall pressure ratio of 5 and a maximum cycle temperature of 550°C. The turbine drives the compressor and an electric generator, the mechanical efficiency of the drive being 97%. The ambient temperature is 20°C and air enters the compressor at a rate of 15kg/s; the isentropic efficiencies of the compressor and turbine are 80% and 83% respectively. Neglecting changes in kinetic energy, the mass flow rate of fuel and pressure loses.

(i) Sketch the open-cycle gas turbine unit (label the important components) and draw the associated T-s diagram **[4 marks]**
(ii) Calculate the compressor work input; **[4 marks]**
(iii) Determine the power output; **[4 marks]**
(iv) Calculate the cycle efficiency; **[4 marks]**
(v) Determine the work ratio. **[4 marks]**

[Data: take the c_p and γ of air as 1.005kJ/kg.K and 1.4 respectively, and as 1.15 kJ/kg K and 1.333 for combustion and expansion processes].

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FAKULTI KEJURUTERAAN
(Faculty of Engineering)

Peralatan & Kawalan
(Instrumentation & Control)

KNJ 3163

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	22 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	2.00 pm – 5.00 pm
Tempat *(Place)*	:	Dewan Kuliah I	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Pn. Shanti Faridah Salleh			

Arahan *(Instruction)* :

1. **Jawab TIGA (3) soalan (Bahagian A) dan jawab SATU (1) soalan sahaja (Bahagian B).**
   (Answer THREE (3) questions from Section A and ONE (1) question only from Section B)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

SECTION A (75%)
Answer THREE questions in this section

QUESTION 1 **[25 marks]**

An aircraft's attitude varies in roll, pitch and yaw as defined in Figure 1. Draw a functional block diagram for a closed loop system that stabilizes the roll as follows: The system measures the actual roll angle with a gyro and compares the actual roll angle with the desired roll angle. The ailerons respond to the roll-angle error by undergoing an angular deflection . The aircraft responds to this angular deflection, producing a roll angle rate. Identify the input and output transducers, the controller, and the plant. Further, identify the nature of each signal.

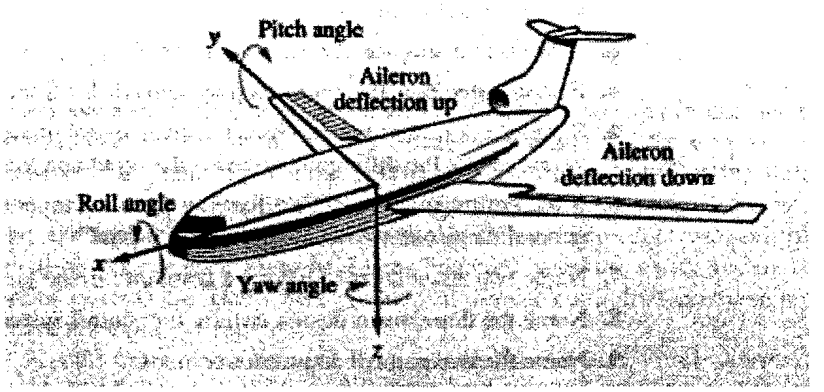


Figure 1

QUESTION 2 **[25 marks]**

For each of the unit step responses shown in Figure 2(a) and (b), find the transfer function of the system.

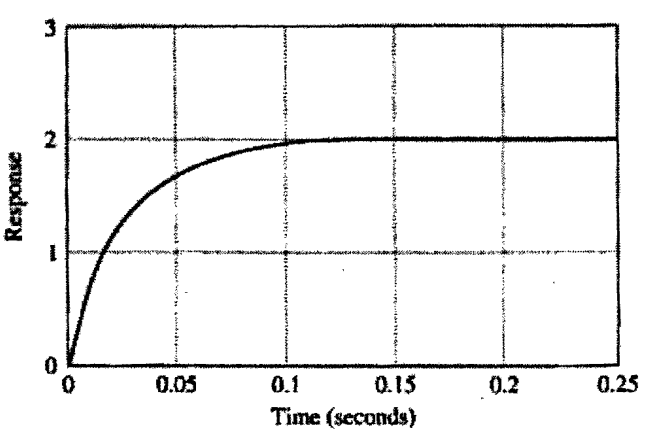


Figure 2(a)

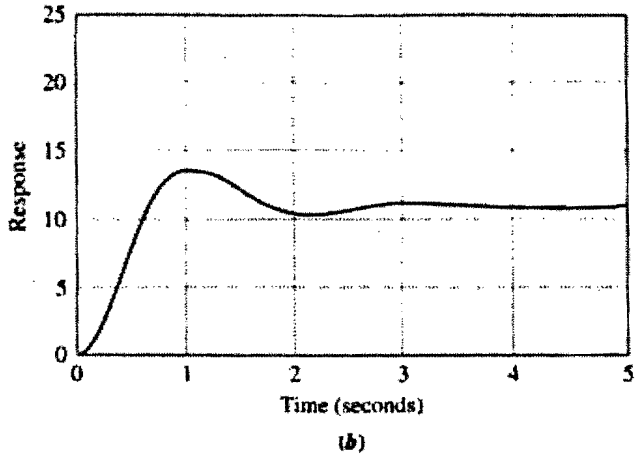


Figure 2(b)

QUESTION 3

Find the following for the system shown in Figure 3.1 and 3.2:

(a) The equivalent single block that represents the transfer function, $T(s) = C(s)/R(s)$ for Figure 3.1. **[11 marks]**

(b) The damping ratio, natural frequency, percent overshoot, settling time, peak time, rise time, and damped frequency of oscillation for Figure 3.1. Figure 3.2 is provided below to assist you in your calculation. **[14 marks]**

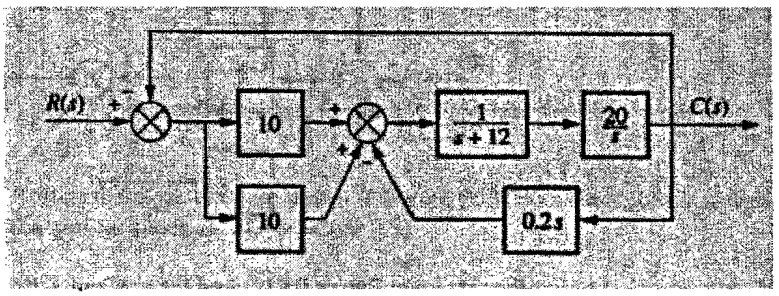


Figure 3.1

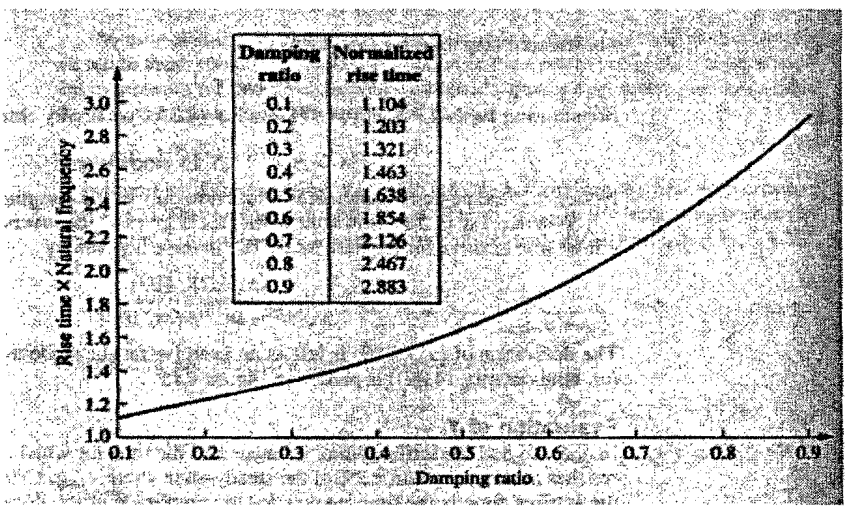


Figure 3.2

QUESTION 4

(a) Name the performance specification for first order system and what does the specification tell us? **[2 marks]**

(b) List five specifications for a second order underdamped system. **[10 marks]**

(c) The following data from Table 1 were obtained from a step response test of an underdamped component. Plot the response curve and determine the 10 to 90% rise time, the overshoot, and the 2% settling time. **[13 marks]**

Table 1

Time (s)	Output (%
0	0.0
5	36.5
10	74.5
13.5	100.0
15	110.0
18.4	120.0
21.8	110.0
24.0	100.0
25.0	96.0
28.4	91.0
30.0	92.0
32.6	96.0
34.0	100.0
36.0	103.0
39.5	105.0
42.5	103.0
44.4	100.0
50.0	97.8
55.0	100.0
60.0	101.0

SECTION B
(25%)
Answer ONE question from this section

QUESTION 5

Arc welding is one of the most important areas of application for industrial robots. In most manufacturing welding situations, uncertainties in dimensions of the part, geometry of the joint, and the welding process itself require the use of sensors for maintaining weld quality. Several systems use a vision system to measure the geometry of the puddle of melted metal as shown in Figure 4. This system uses a constant rate of feeding the wire to be melted.

(a) Calculate the maximum value for K for the system that will result in a stable system. **[13 marks]**

(b) For ½ of the maximum value of K found in part (a), determine the roots of the characteristic. **[12 marks]**

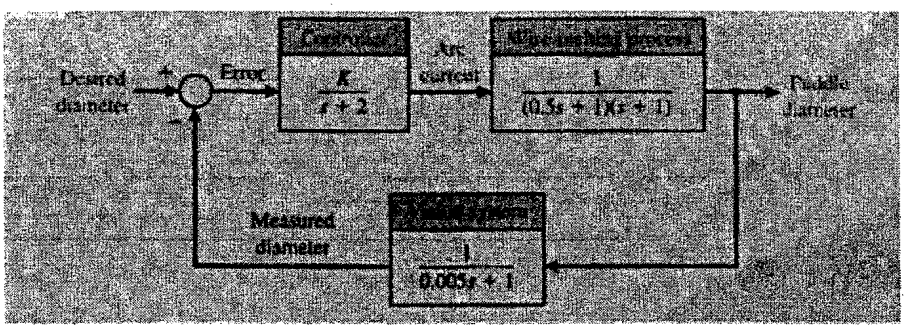


Figure 5

QUESTION 6

During ascent the space shuttle is steered by commands generated by the computer's guidance calculations. These commands are in the form *of* vehicle attitude, attitude rates, and attitude accelerations obtained through measurements made by the vehicle's inertial measuring unit, rate gyro assembly, and accelerometer assembly, respectively. The ascent digital autopilot uses the errors between the actual and commanded attitude, rates, and accelerations to gimbal the space shuttle main engines (called thrust vectoring) and the solid rocket boosters to effect the desired vehicle attitude. The space shuttle's attitude control system employs the same method in the pitch, roll, and yaw control systems. A simplified model of the pitch control system is shown in Figure 7.

a. Find the closed-loop transfer function relating actual pitch to commanded pitch. Assume all other inputs are zero. **[8 marks]**

b. Find the closed-loop transfer function relating actual pitch rate to commanded pitch rate. Assume all other inputs are zero. **[9 marks]**

c. Find the closed-loop transfer function relating actual pitch acceleration to command pitch acceleration. Assume all other inputs are zero. **[8 marks]**

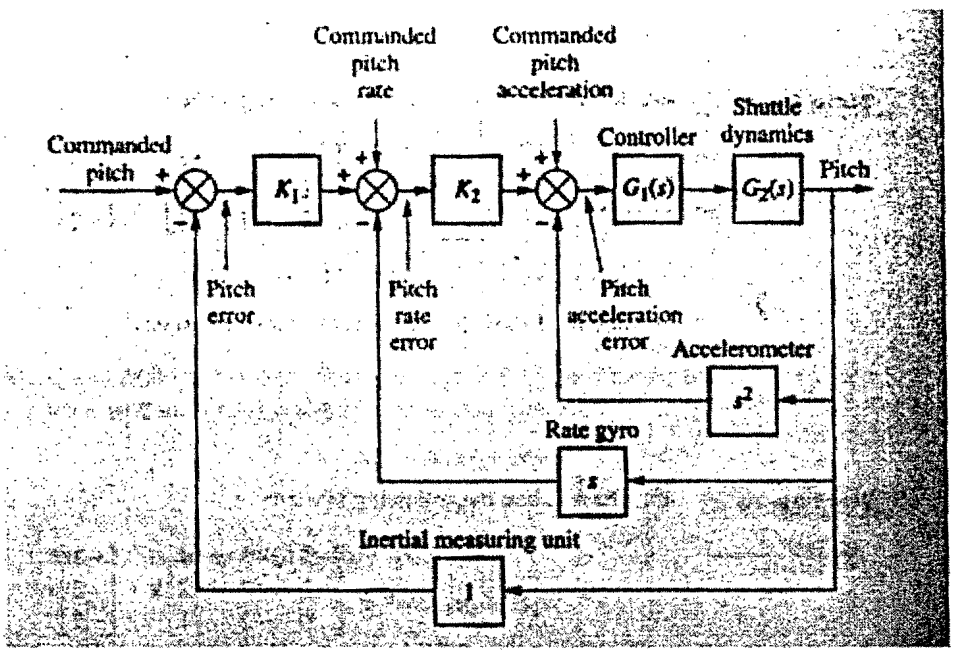

Commanded pitch rate
Commanded pitch acceleration
Commanded pitch
Controller
Shuttle dynamics
Pitch
K_1
K_2
$G_1(s)$
$G_2(s)$
Pitch error
Pitch rate error
Pitch acceleration error
Accelerometer
s^2
Rate gyro
s
Inertial measuring unit
1

Figure 6

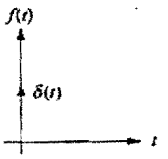
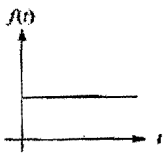
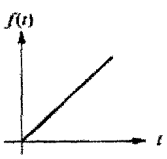
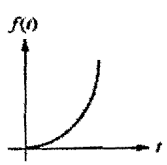
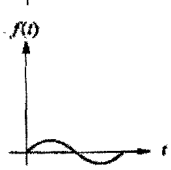
Input	Function	Description	Sketch	Use
Impulse	$\delta(t)$	$\delta(t) = \infty$ for $0- < t < 0+$ $= 0$ elsewhere $\int_{0-}^{0+} \delta(t)\,dt = 1$		Transient response Modeling
Step	$u(t)$	$u(t) = 1$ for $t > 0$ $= 0$ for $t < 0$		Transient response Steady-state error
Ramp	$tu(t)$	$tu(t) = t$ for $t \geq 0$ $= 0$ elsewhere		Steady-state error
Parabola	$\frac{1}{2}t^2u(t)$	$\frac{1}{2}t^2u(t) = \frac{1}{2}t^2$ for $t \geq 0$ $= 0$ elsewhere		Steady-state error
Sinusoid	$\sin \omega t$			Transient response Modeling Steady-state error

Table 1.1 Test waveforms used in control systems

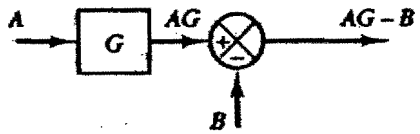
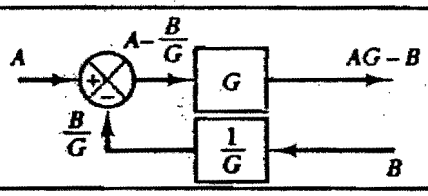
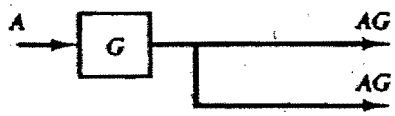
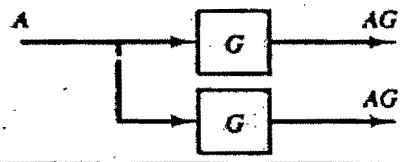
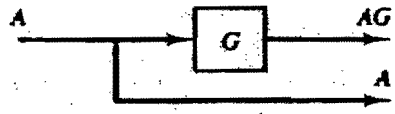
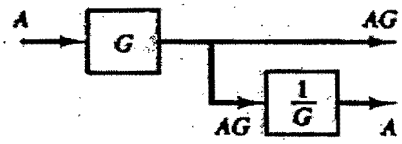
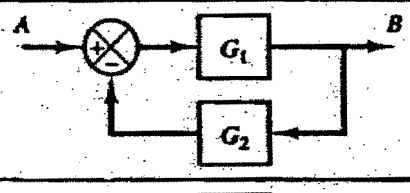
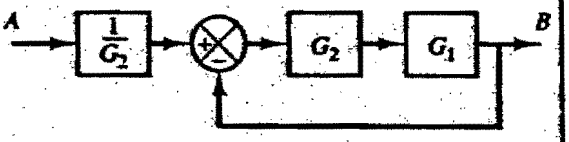
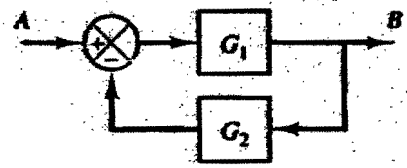
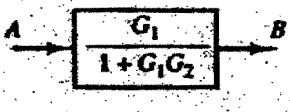
Item no.	f(t)	F(s)
1.	$\delta(t)$	1
2.	$u(t)$	$\frac{1}{s}$
3.	$tu(t)$	$\frac{1}{s^2}$
4.	$t^n u(t)$	$\frac{n!}{s^{n+1}}$
5.	$e^{-at}u(t)$	$\frac{1}{s+a}$
6.	$\sin \omega t u(t)$	$\frac{\omega}{s^2+\omega^2}$
7.	$\cos \omega t u(t)$	$\frac{s}{s^2+\omega^2}$

Table 2.1 Laplace transform table

Item no.	Theorem		Name
1.	$\mathcal{L}[f(t)] = F(s)$	$= \int_{0-}^{\infty} f(t)e^{-st}dt$	Definition
2.	$\mathcal{L}[kf(t)]$	$= kF(s)$	Linearity theorem
3.	$\mathcal{L}[f_1(t) + f_2(t)]$	$= F_1(s) + F_2(s)$	Linearity theorem
4.	$\mathcal{L}[e^{-at}f(t)]$	$= F(s + a)$	Frequency shift theorem
5.	$\mathcal{L}[f(t - T)]$	$= e^{-sT}F(s)$	Time shift theorem
6.	$\mathcal{L}[f(at)]$	$= \frac{1}{a}F\left(\frac{s}{a}\right)$	Scaling theorem
7.	$\mathcal{L}\left[\frac{df}{dt}\right]$	$= sF(s) - f(0-)$	Differentiation theorem
8.	$\mathcal{L}\left[\frac{d^2f}{dt^2}\right]$	$= s^2F(s) - sf(0-) - \dot{f}(0-)$	Differentiation theorem
9.	$\mathcal{L}\left[\frac{d^nf}{dt^n}\right]$	$= s^nF(s) - \sum_{k=1}^{n} s^{n-k}f^{k-1}(0-)$	Differentiation theorem
10.	$\mathcal{L}\left[\int_{0-}^{t} f(\tau)\,d\tau\right]$	$= \frac{F(s)}{s}$	Integration theorem
11.	$f(\infty)$	$= \lim_{s\to 0} sF(s)$	Final value theorem[1]
12.	$f(0+)$	$= \lim_{s\to\infty} sF(s)$	Initial value theorem[2]

[1] For this theorem to yield correct finite results, all roots of the denominator of $F(s)$ must have negative real parts and no more than one can be at the origin.
[2] For this theorem to be valid, $f(t)$ must be continuous or have a step discontinuity at $t = 0$ (i.e., no impulses or their derivatives at $t = 0$).

Table 2.2 Laplace transform theorems

	Original Block Diagrams	Equivalent Block Diagrams
1		
2		
3		
4		
5		

UNIVERSITI MALAYSIA SARAWAK

94300 KOTA SAMARAHAN
SARAWAK

FAKULTI KEJURUTERAAN
(Faculty of Engineering)

Pengawasan Keadaan dan Pengurusan Penyelenggaraan
(Condition Monitoring and Maintenance Management)

KNJ 4203

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	22 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	2.00 – 5.00 pm
Tempat *(Place)*	:	BS 23	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Dr. Mohd Shahril Osman			

Arahan *(Instruction)* :

1. **Jawab semua soalan di Bahagian A dan B.**
   (Answer all questions in Section A and B)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

Section A

Question 1

A vehicle wheel, tire and suspension assembly can be modeled crudely as a single degree of freedom spring mass system. The mass of the assembly is measured to be about 300 kg. Its frequency of oscillation is observed to be 10 rad/s. What is the approximate stiffness of the tire, wheel and suspension assembly?

[5 marks]

Question 2

Consider an airplane wing with a fuel pod mounted at its tip i.e at the wing of the plane. The pod has a mass of 10 kg when it is empty and 1000 kg when it is full. Calculate the change in the natural frequency of vibration of the wing as the airplane uses up the fuel in the wing pod. The estimated physical parameters of the beam are $I = 5.2 \times 10^{-5}$ m^4, $E = 6.9 \times 10^9$ N/m^2 and $l = 2$ m. Given that $\omega = \sqrt{\frac{3EI}{ml^3}}$.

[10 marks]

Question 3

An automobile system shows a single degree of freedom that has an equation of motion of $m\ddot{x} + c\dot{x} + kx = 0$

where m is the mass of the automobile and c and k are the equivalent damping and stiffness of the four shock absorber spring systems. The car deflects the suspension system under its own weight of 0.05m. The suspension is chosen to be critically damped. If the car has a mass of 1361 kg, calculate the equivalent damping and stiffness coefficients of the suspension system. If two passengers, a full gas tank and luggage totaling 290 kg are in the car, how does this affect the effective damping ratio?

(Given that $f = kx$, $c = 2m\omega_n$ and $\zeta = \frac{c}{c_{cr}}$)

[15 marks]

Question 4

A measurement of noise has the following octave band values

Centre Frequency (Hz)	125	250	500	1k	2k	4k	8k
Band Level (dB SPL)1	73	71	70	76	79	75	74

Calculate a) The overall dB SPL

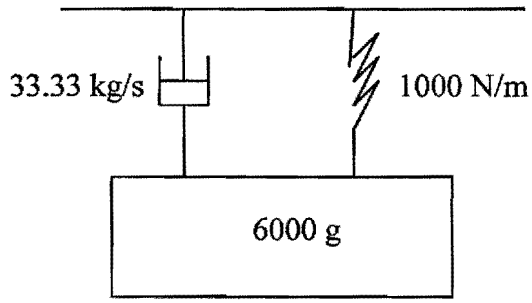
b) The RMS sound pressure in Pascals

$$(L_p = 20\log_{10}(\frac{P_{rms}}{P_0}))\ ; P_o = 20 \text{ x } 10^{-6})$$

[10 marks]

Question 5

A system is given to be:



The solution is given to be $x = \exp(-\zeta\omega_n t)[A \sin \omega_d t + B \cos \omega_d t]$

Find the value of A and B when at rest, $x = 0.05$ m

Given $\omega_d = \sqrt{\frac{k}{m} - (\frac{c}{2m})^2}$

[10 marks]

Section B

Question 6

The following equation describe the forced vibration of a SDOF translating system

$$m\ddot{x} + c\dot{x} + kx = F\exp(j\omega t)$$

a) Derive the complex ratio of vibration displacement amplitude to input force amplitude. **[7 marks]**

b) Describe the use of a Frequency Response Function and show three alternative ways in which it might be displayed, using your answer to a) above as an illustration. **[8 marks]**

c) Explain the following aspects of obtaining a Digital Fourier Transform

i) Aliasing and its prevention

ii) Leakage and its reduction

[10 marks]

Question 7

A rotor system consists of a flywheel, of effectively infinite inertia, and two further rotating inertias joined by light shafts. The flywheel is connected to rotor 1 (moment of inertia 0.1 kgm^2) through a shaft of torsional stiffness 5000 Nm/rad. Rotor 1 is connected to rotor 2 (moment of inertia 0.15kgm^2) through a shaft of torsional stiffness 7000Nm/rad.

a) Calculate the natural frequencies and normal modes of torsional oscillation **[15 marks]**

b) If a harmonic torque of amplitude 100 Nm at 25 Hz is applied to rotor 1, calculate the resulting vibration displacement amplitude of rotor 2. **[10 marks]**

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FAKULTI KEJURUTERAAN

(Faculty of Engineering)

ANALISA MEKANIK DAN MESIN

(Analysis Mechanics & Machines)

KNJ2222

Peperiksaan *(Examination)*	:	AKHIR	**Tarikh** *(Date)*	:	13 OKTOBER 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	2.00 p.m – 4.00 p.m
Tempat *(Place)*	:	**Bilik Seminar 23**	**Jangkamasa** *(Duration)*	:	2 jam
Pensyarah *(Lecturer)*	:	Pn. Ervina Junaidi			

Arahan *(Instruction)* :

1. **Jawab Semua soalan (Bahagian A) dan Jawab TIGA soalan sahaja (Bahagian B) .**
   (Answer All questions from Section A and THREE questions only from Section B)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

Answer ALL questions in Section A and THREE questions from Section B
The maximum marks obtainable for a question are shown in square bracket

SECTION A (40%)
(Answer ALL questions in this section)

A1 a) With the aid of a figure, describe briefly the difference between the following:

i) Simple Link and Complex Link **[2 marks]**

ii) Revolute Joint and Sliding Joint **[2 marks]**

b) Specify the number of links and the number of joints and calculate the mobility for the mechanism shown in the figure below. Identify the item in Figure A1 below as constrained mechanism, locked mechanism or unconstrained mechanism. **[6 marks]**

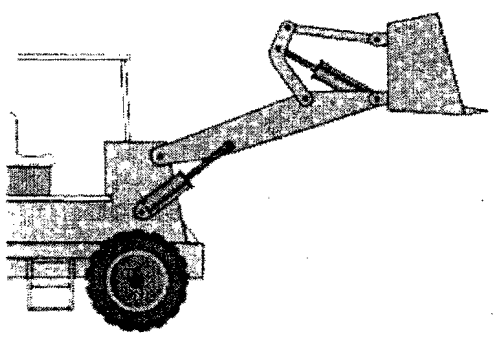


Figure A1

A2 a) With the aid of a figure, explain briefly the term "Backlash". Explain their importance in gear design. **[4 marks]**

b) A mechanism utilizing two spur gears and a rack is shown in Figure A2. Carefully examine the components of the mechanism, and then answer the following leading questions to gain insight into its operation.

i) What is the purpose of this mechanism? **[2 marks]**

ii) What are possible problems with this mechanism? **[2 marks]**

iii) As segment gear A rotates counterclockwise from the position shown, what is the motion of gear B? **[1 marks]**

iv) As segment gear A rotates counterclockwise from the position shown, what is the motion of rack C? **[1 marks]**

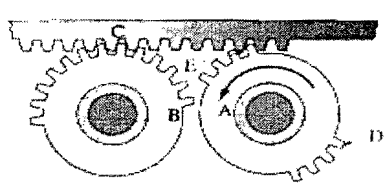


Figure A2

A3 Explain briefly the difference between static and dynamic balancing. **[10 marks]**

A4 With the aid of a figure, explain briefly the difference between free vibration and forced vibration. **[10 marks]**

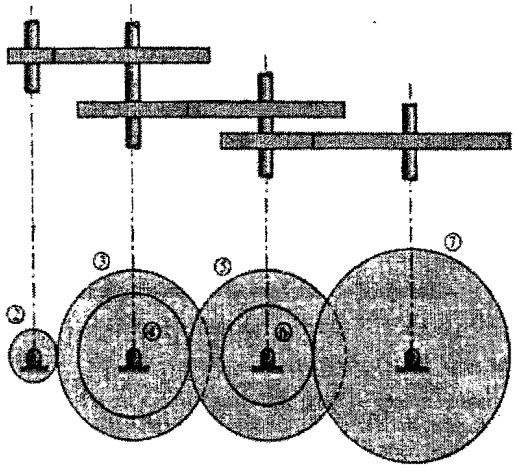
SECTION B (60%)
(Answer THREE questions from this section)

B1 A compound tube of 100mm internal diameter and 200mm external diameter is made by shrinking one tube onto another. After assembly, a radial stress of $20MN/m^2$ is produced at the common surface of 150mm nominal diameter. If the tube is now subjected to an internal pressure of $60MN/m^2$

a) Determine the maximum hoop stress **[13 marks]**

b) Diagrammatically show the hoop stress and radial stress distribution for the compound tube **[7 marks]**

B2 A gear train is shown in Figure B2 below. The gears have the following properties:



Gear 2: T_2= 12 teeth and p_d= 12
Gear 3: D_3 = 2.5 in.
Gear 4: T_4= 15 teeth
Gear 5: D_5= 3.0in. and p_d= 10
Gear 6: D_6 = 1.5 in. and p_d= 8
Gear 7: T_7= 32 teeth

Figure B2

a) Determine the pitch diameter of gear 4 and 7 **[4 marks]**

b) Determine the speed of gear 5 and 7 as gear 2 drives at 1800 rpm **[12 marks]**

c) Determine the distance between the shafts that carry gear 2 and 7 **[4 marks]**

B3 A 20kg casting is bolted to a faceplate of a lathe with its mass center at 22mm from the axis of rotation and 350mm from the faceplate. A machinist gets static balance using two masses of 4kg and 3.5kg respectively. He fixes the 4kg mass at a radius of 38mm from the axis and 120mm from the faceplate. We know that it is possible to balance the casting both statically and dynamically where this will give a complete balance and the rocking couple also will be zero.

a) Draw the front view and the end view of the system above **[5 marks]**

b) Find R_c and l_c **[8 marks]**

c) Explain briefly why for static balance, the resultant of all the centrifugal force must be zero and for dynamic balance, the resultant moment of all the centrifugal forces must be zero? **[7 marks]**

B4 A spring is known to be made from music wire (ASTM A228 steel) but no other data are known. You are able to measure the following features using simple measurement tools:

Free length = 1.75 in.
Outside diameter = 0.561 in.
Wire diameter = 0.055 in.
The ends are squared and ground
The total number of coils is 10.0

The spring will be used in an application where the normal operating load is to be 14.0 lb. Approximately 300 000 cycles of loading are expected. For this spring, compute the following:

a) The mean diameter, inside diameter, spring index and Wahl factor **[8 marks]**
b) The expected stress at the operating load of 14 lb. **[2 marks]**
c) The deflection of the spring under 14 lb. **[3 marks]**
d) The operating length and solid length **[5 marks]**
e) The force on the spring when it is at its solid length **[2 marks]**

TABLE B4 Spring wire modulus of elasticity in shear (G) and tension (E)

Material and ASTM no.	Shear modulus, G (psi)	Shear modulus, G (GPa)	Tension modulus, E (psi)	Tension modulus, E (GPa)
Hard-drawn steel: A227	11.5×10^6	79.3	28.6×10^6	197
Music wire: A228	11.85×10^6	81.7	29.0×10^6	200
Oil-tempered: A229	11.2×10^6	77.2	28.5×10^6	196
Chromium-vanadium: A231	11.2×10^6	77.2	28.5×10^6	196
Chromium-silicon: A401	11.2×10^6	77.2	29.5×10^6	203
Stainless steels: A313				
Types 302, 304, 316	10.0×10^6	69.0	28.0×10^6	193
Type 17-7 PH	10.5×10^6	72.4	29.5×10^6	203
Spring brass: B134	5.0×10^6	34.5	15.0×10^6	103
Phosphor bronze: B159	6.0×10^6	41.4	15.0×10^6	103
Beryllium copper: B197	7.0×10^6	48.3	17.0×10^6	117
Monel and K-Monel	9.5×10^6	65.5	26.0×10^6	179
Inconel and Inconel-X	10.5×10^6	72.4	31.0×10^6	214

Note: Data are average values. Slight variations with wire size and treatment may occur.

UNIVERSITI MALAYSIA SARAWAK

94300 KOTA SAMARAHAN
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FAKULTI KEJURUTERAAN
(Faculty of Engineering)

Kejuruteraan Bahan I
(Engineering Materials I)

KNJ 1042

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	14 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	2.00 pm – 5.00 pm
Tempat *(Place)*	:	Dewan Kuliah I	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Cik Mahshuri Yusof			

Arahan *(Instruction)* :

1. **Jawab semua soalan.**
   (Answer all questions)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

Question 1 (25 marks)

a Draw direction vector and the Miller indices in unit cubes for the following cubic direction/crystallographic plane.

(i) $(10\bar{2})$
(ii) $[\bar{1}\bar{2}2]$

[5 marks]

b Iron at 20 °C is BCC with atoms of atomic radius 0.124 nm. Calculate the lattice constant a for the cube edge of the iron unit cell. **[5 marks]**

c Define isotropic material and give one example.
Define anisotropic material and give one example. **[5 marks]**

d What is nanotechnology? **[5 marks]**

e Define Hardness. List 4 types of tests to determine the hardness of the material. **[5 marks]**

Question 2 (25 marks)

a A brass wire is cold-drawn 25% to a diameter of 1.10 mm. It is then further cold-drawn to 0.900 mm. What is the total percent cold reduction? **[5 marks]**

b Calculate the engineering stress in SI units on a bar 15 cm long and having a cross section of 4.25 mm x 12.0 mm which is subjected to a load 5000 kg. **[5 marks]**

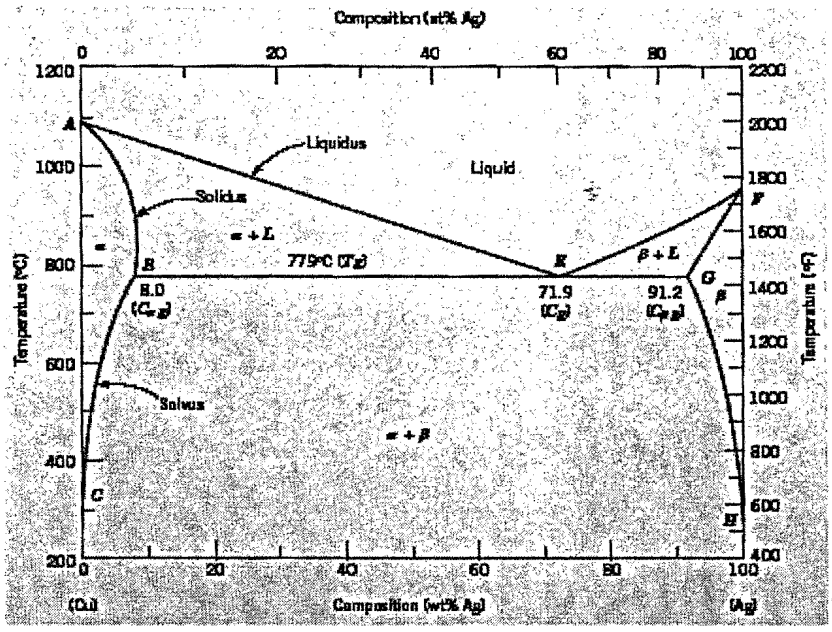
c Consider the binary eutectic copper-silver phase diagram in figure below. Make phase analysis of a 35 wt% Ag-65 wt% Cu alloy at that temperature

(i) 1000 °C
(ii) 800 °C
(iii) 780 °C + ΔT
(iv) 780 °C - ΔT

In the phase analyses include

- The phases present
- The chemical compositions of the phases
- The amounts of each phase
- Sketch the microstructure.

[15 marks]



Question 3 (25%)

a. Describe and illustrate the following imperfections which can exist in crystal lattices:
   (i) Frenkel imperfection and
   (ii) Schottky imperfection **[5 marks]**

b. Describe and illustrate the edge and screw type dislocations. What types of strain fields surround both types of dislocations? **[5 marks]**

c. Describe the structure of a grain boundary. Why are grain boundaries favorable sites for the nucleation and growth of precipitates? **[5 marks]**

d. Consider a single crystal of BCC iron oriented such that a tensile stress is applied along a [010] direction.
   (i) Compute the resolved shear stress along a (110) plane and in a $[\bar{1}11]$ direction when a tensile stress of 52 MPa (7500 psi) is applied. **[5 marks]**
   (ii) If slip occurs on a (110) plane and in a $[\bar{1}11]$ direction, and the critical resolved shear tress is 30 MPa (4350 psi), calculate the magnitude of the applied tensile stress necessary to initiate yielding. **[5 marks]**

Question 4 (25%)

a. Illustrate:
   (i) Single lap joint
   (ii) Strapped lap joint
   (iii) Doubler lap joint
   (iv) Butt joint
   (v) Peel joint **[5 marks]**

b. Illustrate the distribution of
   (i) shear stress and peel stress in single lap joint
   (ii) shear stress and peel stress in butt joint
   (iii) peel stress in peel joint **[15 marks]**

c. List four broad types of resins used in adhesives. **[5 marks]**

UNIVERSITI MALAYSIA SARAWAK

94300 KOTA SAMARAHAN
SARAWAK

FAKULTI KEJURUTERAAN

(Faculty of Engineering)

Kejuruteraan Bahan II

(Engineering Materials II)

KNJ 2112

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	15 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	9.00 am – 12.00 pm
Tempat *(Place)*	:	Bilik Seminar 11	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Cik Mahshuri Yusof			

Arahan *(Instruction)* :

1. **Jawab semua soalan.**
   (Answer all questions)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

Question 1 (25%)

a. Draw time-temperature cooling paths for a 1080 steel on an isothermal transformation diagram that will produce the following microstructures. Start with the steels in the austenitic condition at time= 0 and 850 °C.

(a) 100% martensite
(b) 50% martensite and 50% coarse pearlite
(c) 100% fine pearlite
(d) 50% martensite and 50% upper bainite
(e) 100% upper bainite
(f) 100% lower bainite **[12 marks]**

b What is surface hardening of steel? List 3 of the surface hardening methods. **[8 marks]**

c. Draw a figure of setup of Jominy end-quench test and explain briefly the test in order to determine the hardenability of the metal. **[5 marks]**

Question 2 (25%)

a. Arsenic is diffused into a thick slice of silicon with no previous arsenic in it at 1100 °C. If the surface concentration of the arsenic is 5.0×10^{18} atoms/cm^3 and its concentration at 1.2 μm below the silicon surface is 1.5×10^{16} atoms/cm^3, determine the diffusion time? ($D=3.0 \times 10^{-14}$ cm^2/s for As diffusing in Si at 1100 °C). See Appendix - Tabulation of Error Function Values **[10 marks]**

b. A sample of pure iron oxidizes according to the linear oxidation rate law. After 4 hours at 720 °C, a 1 cm^2 sample shows a weight gain of 8μg/cm^2. Determine the oxidation time for the sample to show a weight gain of 45μg/cm^2? **[10 marks]**

c. A galvanic cell consists of an electrode of zinc in a 1M $ZnSO_4$ solution and another of nickel in a 1 M $NiSO_4$ solution. The two electrodes are separated by a porous wall so that mixing of the solutions is prevented. An external wire with a switch connects the two electrodes. When the switch is just closed: (See Appendix - Table Standard Electrode Potential at 25 °C)

(a) At which electrode does oxidation occur?
(b) Which electrode is the anode of the cell?
(c) Which electrode corrodes?
(d) What is the emf of this galvanic cell when the switch is just closed? **[5 marks]**

Question 3 (25%)

a. How the defect or flaws can be detected in
   (i) Ultrasonic Testing (UT),
   (ii) Penetrant Testing (PT), and
   (iii) Acoustic Emission **[15 marks]**

b. What are the characteristics of a surface of a ductile fracture of a metal and describe three stages in the ductile fracture of a metal. **[5 marks]**

c. What are the characteristics of the surface of a brittle fracture of a metal? Describe the three stages in the brittle fracture of a metal. **[5 marks]**

Question 4 (25%)

a. Describe a metal fatigue failure. Where do fatigue failures usually originate on a metal section? **[5 marks]**

b. A fatigue test is made with a mean stress of 15,000 psi (103 MPa) and a stress amplitude of 20,000 Psi (138 MPa). Calculate (a) the maximum and minimum stresses, (b) the stress ratio, and (c) the stress range. **[10 marks]**

c. What is metal creep? For which environment conditions are the creep of metals especially important industrially? **[5 marks]**

d. Describe what occurs metallurgically at each stage of creep. **[5 marks]**

APPENDIX

Table Standard Electrode Potential at 25 °C

Oxidation (corrosion) reaction	Electrode potential, E° (volts vs standard hydrogen electrode)
$Au \rightarrow Au^{3+} + 3e^-$	+1.498
$2H_2O \rightarrow O_2 + 4H^+ + 4e^-$	+1.229
$Pt \rightarrow Pt^{2+} + 2e^-$	+1.200
$Ag \rightarrow Ag^+ + e^-$	+0.799
$2Hg \rightarrow Hg_2^{2+} + 2e^-$	+0.788
$Fe^{2+} \rightarrow Fe^{3+} + e^-$	+0.771
$4(OH)^- \rightarrow O_2 + 2H_2O + 4e^-$	+0.401
$Cu \rightarrow Cu^{2+} + 2e^-$	+0.337
$Sn^{2+} \rightarrow Sn^{4+} + 2e^-$	+0.150
$H_2 \rightarrow 2H^+ + 2e^-$	0.000
$Pb \rightarrow Pb^{2+} + 2e^-$	−0.126
$Sn \rightarrow Sn^{2+} + 2e^-$	−0.136
$Ni \rightarrow Ni^{2+} + 2e^-$	−0.250
$Co \rightarrow Co^{2+} + 2e^-$	−0.277
$Cd \rightarrow Cd^{2+} + 2e^-$	−0.403
$Fe \rightarrow Fe^{2+} + 2e^-$	−0.440
$Cr \rightarrow Cr^{3+} + 3e^-$	−0.744
$Zn \rightarrow Zn^{2+} + 2e^-$	−0.763
$Al \rightarrow Al^{3+} + 3e^-$	−1.662
$Mg \rightarrow Mg^{2+} + 2e^-$	−2.363
$Na \rightarrow Na^+ + e^-$	−2.714

Tabulation of Error Function Values

z	erf(z)	Z	erf(z)	z	erf(z)
0	0	0.55	0.5633	1.3	0.9340
0.025	0.0282	0.60	0.6039	1.4	0.9523
0.05	0.0564	0.65	0.6420	1.5	0.9661
0.10	0.1125	0.70	0.6778	1.6	0.9763
0.15	0.1680	0.75	0.7112	1.7	0.9838
0.20	0.2227	0.80	0.7421	1.8	0.9891
0.25	0.2763	0.85	0.7707	1.9	0.9928
0.30	0.3286	0.90	0.7970	2.0	0.9953
0.35	0.3794	0.95	0.8209	2.2	0.9981
0.40	0.4284	1.0	0.8427	2.4	0.9993
45	0.4755	1.1	0.8802	2.6	0.9998
0.50	0.5205	1.2	0.9103	2.8	0.9999

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94300 KOTA SAMARAHAN
SARAWAK

FAKULTI KEJURUTERAAN

(Faculty of Engineering)

Bahan Lanjutan

(Advanced Materials)

KNJ 3173

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	11 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	9.00 a.m – 12.00 p.m
Tempat *(Place)*	:	BS23	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Prof. Madya Dr. Sinin Hamdan			

Arahan *(Instruction)* :

1. **Jawab semua soalan.**
   (Answer all questions)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

1. Fibre type has a significant effect on impact resistance under low velocity impact, during which fibres must be able to store energy elastically. Name several factors that are relevant to the role of fibre type in impact. **(3 Marks)**

2. Matrix properties are a significant factor in determining the impact behaviour and subsequent load-bearing ability of a composite. Explain? **(3 marks)**

3. Described 'Thermal Spiking' **(3 marks)**

4. Since the level of residual stress developed in a composite laminate as a result of thermal expansion coefficient mismatch depends on temperature, list the damages due to the continuously varying temperature. **(3 marks)**

5. Creep can be a problem for un-reinforced polymers at relatively low stresses and temperatures (compared with their ultimate strength and T_g). Using fibres, explain how to eliminate creep. **(3 marks)**

6. Explain how moisture diffused into the composite. **(3 marks)**

7. Illustrate with proper figure the relative water absorption behaviour of Carbon/Epoxy, Glass/Epoxy and Kevlar/Epoxy fibre composite compared to the bulk epoxy **(3 marks)**.

8. Explain the different moisture effect on the thermoset polymer matrix as compared to crystalline and semi-crystalline polymer matrix **(3 marks)**.

9. At high strain rate, deformation is more localized at the point of impact. Explain the mechanism how the energy is dissipated. (**3 marks**)

10. Explain why the ply stacking sequence is important. (**3 marks**)

11. List the possible measure to reduce the tendency for delamination. (**3 marks**)

12. Long chain polymers are susceptible to property changes as a result of chain scission that reduces the average polymer molecular weight, the softening temperature and the strength. In contrast to chain scission, explain the causes of additional cross-linking. (**3 marks**)

13. Space environment can degrade the properties of polymer composites used in spacecraft, e.g. for structure with a service life of 10 to 30 years in geosynchronous earth orbit (GEO) or low earth orbit (LEO). What are the effects cause by the space environment? (**4 marks**)

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FAKULTI KEJURUTERAAN

(Faculty of Engineering)

Mekanik Bendalir II

(Fluid Mechanics II)

KNJ 2104 / KNJ 2103

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	11 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	9.00 am – 12.00 pm
Tempat *(Place)*	:	Bilik Seminar 12	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Dr. Andrew RH Rigit			

Arahan *(Instruction)* :

1. **Jawab semua EMPAT (4) soalan.**
   (Answer all FOUR (4) questions)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

Question 1

a. A hydrofoil 50 cm long and 4 m wide moves at 14.4m/s in seawater at 20°C. Using flat-plate theory with Re_{tr} = 5E5, estimate its drag, in N, for (i) a smooth wall, and (ii) a rough wall, ε = 0.3 mm.

Note:
For seawater at 20°C, density ρ = 1025 kg/m^3 and viscosity μ = 0.00107 kg/m.s.

Drag coefficient C_D for:

(i) smooth plate, $C_D = \frac{0.031}{Re_L^{1/7}} - \frac{1440}{Re_L}$

(ii) rough plate, $C_D \approx \left(1.89 + 1.62 \log \frac{L}{\varepsilon}\right)^{-2.5}$

(or use Fig. 1 to estimate C_D) **[15 marks]**

b. A sea-level smokestack is 52 m high and has a square cross section. Its supports can withstand a maximum side force of 90 kN. If the stack is to survive 40.2 m/s hurricane winds, what is its maximum possible (square) width?

Note:
For sea-level air, take density ρ = 1.225 kg/m^3 and viscosity μ = 1.78E-5 kg/m.s.
Assume Re > 1E4 and for square cylinder, C_D = 2.1. **[10 marks]**

Question 2

a. Air flows in a duct of diameter 5 cm. At one section, T_0 = 300 °C, P = 120 kPa, and $\dot{m}$ = 0.4 kg/s. Estimate, at this section,
(i) Velocity, V, (ii) Ma, and (iii) ρ_0.

Note: k = 1.4 and c_p = 1005 m^2/s^{2}K for air.
Warning: This is a compressible flow, thus fluid density is not constant. **[15 marks]**

b. A large vacumm tank, held at 60 kPa absolute, sucks air, at sea-level standard, through a converging nozzle of throat diameter 3 cm. Estimate
(i) the mass flow rate, and
(ii) the Mach number at the throat.

Note: For sea level air, take T_o = 288 K, P_o = 10135 Pa, ρ_o = 1.225 kg/m^3 and k = 1.4. **[10 marks]**
Warning: You must calculate air density at the throat.

Question 3

a. Air at 20°C and 1 atm flows at 20 m/s past the flat plate in Fig. Q3. A pitot stagnation tube, placed 2 mm from the wall, develops a manometer head h = 16 mm of Meriam red oil, SG = 0.827. Use this information and Blasius solution to estimate the downstream position x of the pitot tube. Assume laminar boundary layer flow and constant stream pressure. **[10 marks]**

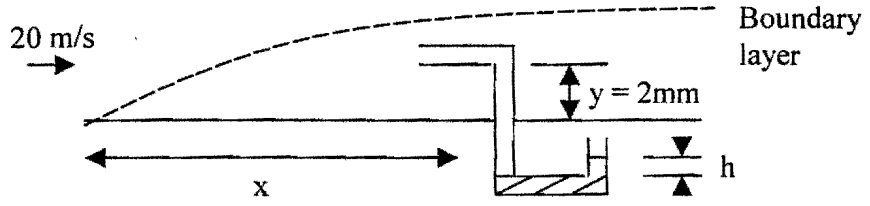


Fig. Q3

Note: Air at 20°C, density ρ = 1.2 kg/m^3 and viscosity μ = 1.8x10^{-5} kg/m.s.

b. A thin flat plate 55 by 110 cm is immersed in a 6 m/s stream of SAE 30 oil at 20 deg C. **[15 marks]**
(i) Compute the total friction drag if the stream is parallel to the long side.
(ii) If the liquid is water, determine if the boundary layer is laminar or turbulent, and re-calculate the total friction drag.

Note: SAE oil at 20°C: density ρ = 891 kg/m^3, viscosity μ = 3.25 x 10^{-4} m^2/s. Water at 20°C: density ρ = 998 kg/m^3, viscosity μ = 1 x 10^{-6} m^2/s.

Question 4

a. An idealized radial turbine is shown in Fig. Q4. The absolute flow enters at 25 degrees with the blade angles as shown. The flow rate is 8 m^3/s of water at 20°C. The blade thickness is constant at 20 cm. Calculate the theoretical power developed at 100% efficiency.

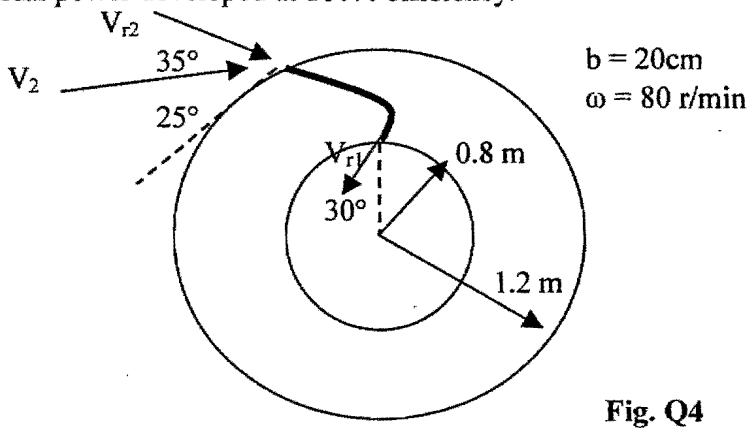
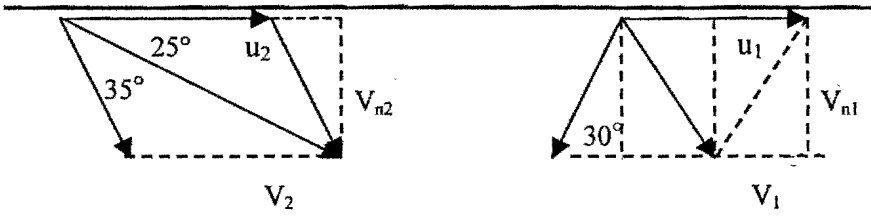


Fig. Q4



[15 marks]

Note:
Detailed velocity vector diagrams at (2) outlet and (1) inlet for Fig. Q4.

b. A pump delivers gasoline at 20 deg Celcius and 12 m^3/hr. At the inlet, p_1 = 100 kPa, z_1 = 1m, and V_1 = 2 m/s. At the exit p_2 = 500 kPa, z_2 = 4 m and V_2 = 3 m/s. How much power is required if the motor efficiency is 75%?

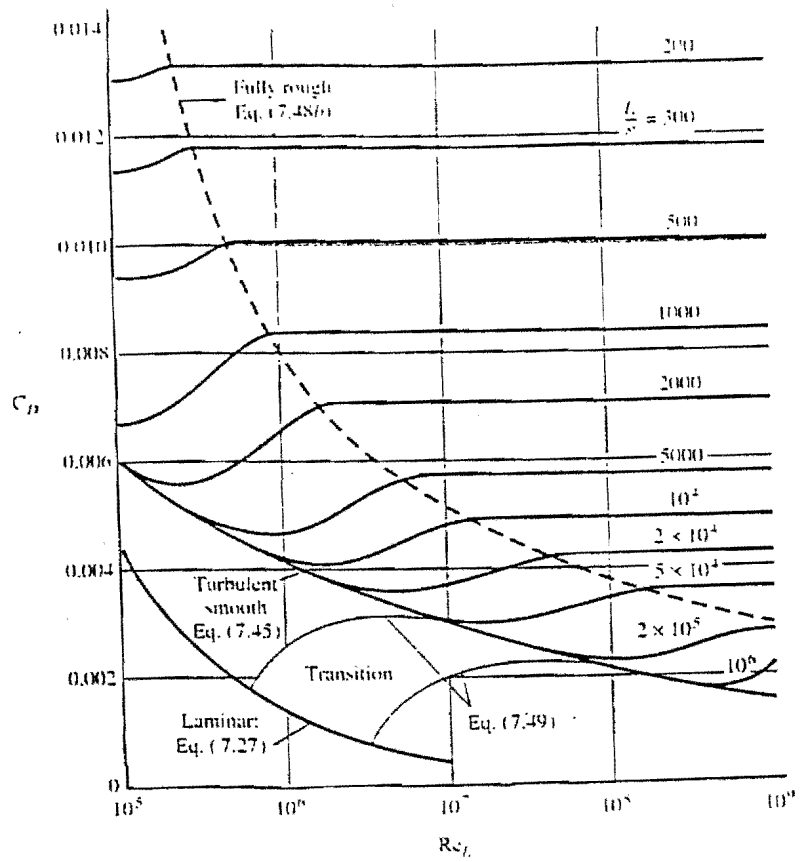
Note: For gasoline, take ρg = 690(9.81) = 6671 N/m^3. **[10 marks]**

Appendices

Table 1: The Blasius Velocity Profile

$y[U/(vx)]^{1/2}$	u/U	$y[U/(vx)]^{1/2}$	u/U
0.0	0.0	2.8	0.81152
0.2	0.06641	3.0	0.84605
0.4	0.13277	3.2	0.87609
0.6	0.19894	3.4	0.90177
0.8	0.26471	3.6	0.92333
1.0	0.32979	3.8	0.94112
1.2	0.39378	4.0	0.95552
1.4	0.45627	4.2	0.96696
1.6	0.51676	4.4	0.97587
1.8	0.57477	4.6	0.98269
2.0	0.62977	4.8	0.98779
2.2	0.68132	5.0	0.99155
2.4	0.72899	∞	1.00000
2.6	0.77246		

Figure 1: Drag coefficient of laminar and turbulent boundary layers on smooth and rough flat plates.



UNIVERSITI MALAYSIA SARAWAK

94300 KOTA SAMARAHAN
SARAWAK

FAKULTI KEJURUTERAAN

(Faculty of Engineering)

Sistem Kawalan Proses

(Process Control Systems)

KNJ4183

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	19 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	2.00 – 5.00 pm
Tempat *(Place)*	:	**Dewan Kuliah 1**	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Dr. Andrew R.H. Rigit			

Arahan *(Instruction)* :

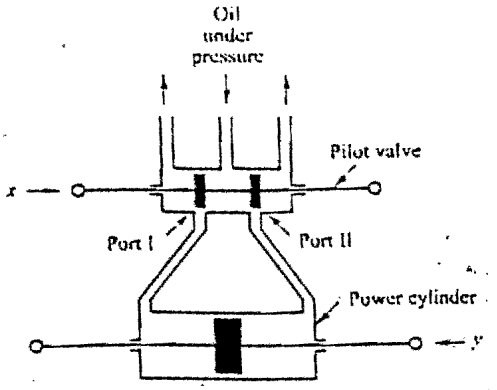
1. **Jawab semua empat soalan.**
   (Answer all four (4) questions).
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam kertas jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer sheets provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

Question 1

a. (i) The fluid generally found in pneumatic control systems is air; in hydraulic systems it is oil. And it is primarily the different properties of the fluids involved that characterize the differences between the two systems. List down five (5) key differences between the two systems. **[5 marks]**

(ii) There are certain advantages and disadvantages in using hydraulic systems rather than pneumatic systems. List down five main advantages and five main disadvantages of a hydraulic control system. **[10 marks]**

b. (i) A pilot-valve-controlled hydraulic power amplifier and actuator hydraulic servomotor as shown in Fig. Q1 acts as an integral controller. Such a servomotor constitutes the basis of the hydraulic control circuit. Derive the transfer function for the hydraulic servomotor. Note that the rate of flow of oil q (in kg/s) times dt (in seconds) is equal to the power piston displacment dy (in metre) times the piston area A (in m^2) times the density of oil ρ (in kg/m^3). **[5marks]**



(ii) Describes how the servomotor in Fig. Q1 can be modified to a proportional controller by means of a feedback link. **[5 marks]**

Question 2

a. The majority of measurement signals are still transmitted over wires. Proper wiring practices play an important role in the total performance of process control systems. The ability of a process control system to perform is directly dependent upon the quality of the measured variables. This quality is dependent upon the elimination or attenuation of noise that can deteriorate the actual transducer signal. The good wiring practices and signal conditioning techniques are meant to remove the noise signal from the transducer signal.

(i) What are the four main noise sources? **[4 marks]**

(ii) What are the three good practice steps that need to be followed in order to reduce noise? **[6 marks]**

b. There are many sources of noise interference. Describe the following five most common sources of noise interference:
   (i) inductive pickup from power sources
   (ii) electrostatic coupling to AC signals
   (iii) variable contact resistance
   (iv) conduction pickup
   (v) thermoelectric drift. **[10 marks]**

c. Once the noise signal is identified, its elimination involves applying the basic rules. List five of these basic rules. **[5 marks]**

Question 3

a. Process simulation has an expanding role in many aspects of industrial production, including research, design, operations, maintenance, and regulation compliance.
Describe when the four of the following five-types of simulations are employed or used:
   (i) dynamic simulations
   (ii) steady-state simulations
   (iii) dynamic discrete simulations
   (iv) dynamic continuous simulations
   (v) real-time simulations **[10 marks]**

b. Describe how the following processes are dynamically simulated:
   (i) Simulation of temperature-related processes
   (ii) Simulation of pressure-related processes **[10 marks]**

c. The management of change and the desire for increased automation and design efficiency will be the impetus for integration of simulation, computer-aided design, and Distributed Control Systems (DCS) or Programmable Logic Controllers (PLC) configurations.
Describe how these simulations would run on-line faster than real time to project future failures and violations of operating constraints that will facilitate global on-line optimization of processes. **[5 marks]**

Question 4

a. Expert system applications to process control can be divided into two areas: control system design and real-time process control.

(i) In an expert system for design, the goal is to capture the expertise of the design engineer to reduce the design time and to produce an optional design.
Describe, with an example of a control system engineer who is an expert on distillation control to illustrate the above statement. **[7 marks]**

(ii) In the area of real-time control, expert systems have been applied in many areas, including batch process control, fault diagnosis, and statistical process control (SPC).
Describe, with an example, the application of expert systems to fault diagnosis for an industrial process. **[8 marks]**

b. (i) Batch processes may be classified by product and grade variation.
Describe, in three (3) ways, how a batch process can be classified by product and grade variation. **[3 marks]**

(ii) List the four types of control equipment used for batch control, and describe how they are applied to batch control. **[7 marks]**

FAKULTI KEJURUTERAAN

SET-SET SOALAN
KEJURUTERAAN ELEKTRONIK

25 OKTOBER 2004

UNIVERSITI MALAYSIA SARAWAK

94300 KOTA SAMARAHAN
SARAWAK

FAKULTI KEJURUTERAAN

(Faculty of Engineering)

Rangkaian dan Perkhidmatan Telekomunikasi (Telecommunication Networks and Services)

KNT4073

Peperiksaan *(Examination)*	:	**Akhir**	**Tarikh** *(Date)*	:	**14 Oktober, 2004**
Semester	:	**Sesi I 2004/2005**	**Masa** *(Time)*	:	**9.00 a.m – 12.00 p.m**
Tempat *(Place)*	:	**SR 11**	**Jangkamasa** *(Duration)*	:	**3 jam**
Pensyarah *(Lecturer)*	:	**En Thelaha Masri**			

Arahan *(Instruction)* :

1. **Soalan didalam kertas ini dibahagi kepada 2 bahagian ,**
   Bahagian A: Jawab semua soalan
   Bahagian B: Jawab mana-mana DUA (2) soalan sahaja
   This exam paper consists of two sections.
   Section A: Answer ALL questions
   Section B: Answer any TWO (2) questions only
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam kertas jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer sheets provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

SECTION A: Answer **all** questions in section A

Question 1

In its simplest form, a telecommunication network can be defined as a set of equipment and facilities that provides a service: transfer of information between users located at various geographical points. In other words, a telecommunication network:

i. distribute information

ii. provide access for gathering information

iii. essential infrastructure in every society

iv. transmit information at high speed

v. flexible in their use

Based on the above definition, give one example of a service that is familiar to you that suite this discussion. For example, the Broadcasting Department (Radio or TV), Telephone services, the Police or Traffic communication networks & services, the ship to shore Communication or Computer networks & services etc.

Draw a diagram / block diagram that shows the main functions of every section involved in the department and you should also sketch the basic network & facilities / links, if any. (Include the equipment, studios, communication equip, controlling room, etc.)

[20 marks]

Question 2

For a special case, the 'Erlang's lost-call formula' is written as

$$B = E_{1,N}(A) = \frac{A^N/N!}{\sum_{k=0}^{N} A^k/k!},$$

which denotes the loss probability for a full availability group N trunks offered traffic A erlangs, whereby the first Erlang distribution formula is computed as

$$P(x) = \frac{A^x/x!}{\sum_{k=0}^{N} A^k/k!}.$$

If a group of five trunks is offered 2E of traffic, using the formula given above, find,

i. The grade of service. **[6 marks]**

ii. The probability that only one trunk is free. **[4 marks]**

iii. The probability that only one trunk is busy. **[4 marks]**

iv. The probability that at least one trunk is free. **[6 marks]**

Question 3

(a) On average, one call arrives every 5 seconds. During a period of 30 seconds, what is the probability that:

i No call arrives? **[3 marks]**

ii One call arrives? **[3 marks]**

iii Two calls arrive? **[3 marks]**

iv More than **seven** calls arrive? **[8 marks]**

(b) Define the term "traffic intensity". **[3 marks]**

SECTION B: Answer **ANY TWO (2)** questions only.

Question 1

(a) Explain what is central office (CO), and explain what is the function of a central office in the telecommunication system.

[7 marks]

(b) List down several signalling and control use in PSTN.

[6 marks]

(c) Explain what is In-Band Signalling and Control and how it is different from Out-of Band Signalling and control?

[7 marks]

Question 2

(a) What are the most attractive characteristic and benefit of ISDN compare to PSTN?

[5 marks]

(b) ISDN is currently available in two interface varieties; the BRI and PRI. Explain briefly what are BRI and PRI in terms of channel and channel rate.

[6 marks]

(c) What are Terminal Equipment (TE) and Terminal Adapters (TA) in ISDN?

[5 marks]

(d) You can call other ISDN users, which could be remote sites in your own IS organization, public BBSs, customer sites for EDI or transaction processing, or commercial online services such as CompuServe. The data applications of ISDN require that both parties in the connection have ISDN or packet data service.

Now, what if you need to connect with somebody that isn't ISDN capable? Explain your answer briefly on how to handle this problem, using a suitable diagram.

[4 marks]

Question 3

(a) ATM data can be of 3 types. Name and explain each of the 3 types. (You can give examples to the application of each type to support your view).

[6 marks]

(b) ATM is based on a 53-octet cell structure comprising 48 octets of payload and 5 octets of overhead. Draw the ATM cell structure showing also the content of the 5-octet header.

[6 marks]

(d) Discuss the advantages and disadvantages of ATM.

[8 marks]

Question 4

(a) What is Common Channel Signalling System No.7 (SS7)? What is it used for?

[5 marks]

(b) There are 3 types of signalling points in the SS7 network. Explain the function of each point. Draw a diagram to support your answer.

[5 marks]

(c) List down several advantages and disadvantages of Frame Relay.

[6 marks]

(d) What is Wireless Local Loop (WLL) and explain how WLL can save cost when implemented.

[4 marks]

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FAKULTI KEJURUTERAAN

(Faculty of Engineering)

Optoelektronik

(Optoelectronics)

KNT3113

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	22 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	9.00 pagi – 12.00 tgh
Tempat *(Place)*	:	Dewan Kuliah 1	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Dr. Awangku Abdul Rahman B. Pgn Hj Yusof			

Arahan *(Instruction)* :

1. **Pilih dan jawab empat (4) soalan sahaja.**
   (Select and answer four (4) questions only).
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam kertas jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer sheets provided using pen only)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (Do not talk or disturb other candidates during the duration of the examination)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

Question 1

(a) State the three criteria that semiconductor materials must fulfill in order to satisfy the requirement for an optical source. **[5 marks]**

(b) With the aid of suitable diagrams, discuss the principle of operation of the double heterojunction Light Emitting Diode (LED). **[5 marks]**

Question 2

(a) A gallium arsenide injection laser with a cavity of length 550μm has a loss coefficient of 23 cm^{-1}. The measured differential external quantum efficiency of the device is 45%. Calculate the internal quantum efficiency of the laser. The refractive index of gallium arsenide is 3.6. **[5 marks]**

(b) The coated mirror reflectivity at either end of the 350μm long optical cavity of an injection laser is 0.55 and 0.60. At normal operating temperature, the threshold current density for the device is 2.2×10^{3} A cm^{-2} and the gain factor β is 25×10^{-3} cm A^{-1}. Estimate the loss coefficient in the optical cavity. **[5 marks]**

Question 3

A planar LED is fabricated from gallium arsenide which has a refractive index of 3.6.

(a) Calculate the optical power emitted into air as a percentage of the internal optical power for the device when the transmission factor at the crystal-air interface is 0.65. **[5 marks]**

(b) When the optical power generated internally is 60% of the electrical power supplied, determine the external power efficiency. **[5 marks]**

Question 4

(a) Optical detectors are generally categorized into two different types; photon and thermal detectors. Photon detectors may be further subdivided into three different groups. Describe briefly the principle of detection of each of these three groups. **[6 marks]**

(b) Describe briefly the following types of noise generally found in optical detectors.

i) Johnson noise **[2 marks]**

ii) Shot noise **[2 marks]**

Question 5

A digital optical fiber communication system operating at a wavelength of $1.3\mu m$ requires a maximum bit error rate of 10^{-10}. Determine:

(a) the theoretical quantum limit in the receiver in terms of the quantum efficiency of the detector and the energy of an incident photon. **[4 marks]**

(b) the minimum incident optical power required at the detector in order to achieve the above bit error rate when the system is employing ideal binary signaling at 12 Mbits s^{-1}, and assuming the detector is ideal. **[6 marks]**

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FAKULTI KEJURUTERAAN

(Faculty of Engineering)

SISTEM KOMUNIKASI OPTIK

(Optical Communication System)

KNT4063

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	21 Oktober 2004
Semester	:	Semester1 Sesi 2004/2005	**Masa** *(Time)*	:	9.00 am – 12.00 pm
Tempat *(Place)*	:	Bilik Seminar 12	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Martin Anyi			

Arahan *(Instruction)* :

1. **Jawab lima (5) soalan sahaja.**
   (Answer five questions only)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

Question 1

Explain (with diagrams), what do you understand by:

a. Critical angle **[3 marks]**

b. Total Internal reflection and **[3 marks]**

c. Numerical aperture. **[4 marks]**

Question 2

a. One of the advantages of fiber optic is immunity to interference and crosstalk. Explain briefly what are interference and crosstalk in telecommunication. Based on your explanation, further explain why fiber optic is immune to both interference and crosstalk. **[6 marks]**

b. Explain why fiber optic system has high signal security. **[4 marks]**

Question 3

A silica optical fiber has a core reflective index of 1.5 and a cladding refractive index of 1.47. Determine:

a. The critical angle at the core-cladding interface. **[3 marks]**

b. The NA for the fiber. **[3 marks]**

c. The acceptance angle in air for the fiber. **[4 marks]**

Question 4

a. Explain skew rays and state it advantage over the meridional rays. **[4 marks]**

b. An optical fiber in air has NA of 0.4. Compare the acceptance angle for the meridional rays with that of skew rays which change direction by 100° at each reflection. **[6 marks]**

Question 5

a. Estimate the maximum core diameter for an optical fiber with relative refractive index difference of 1.5%, core refractive index of 1.48 and operating wave length of 0.85 μm so that it may possible for single mode operation. **[6 marks]**

b. Explain match cladding (MC) and depressed cladding (DC) used in fiber optic technology. **[4 marks]**

Question 6

a. When the mean optical power launched into an 8 km length of fiber is 120 μW, the mean optical power at the fiber output is 3 μW. Determine:

i. The overall signal attenuation or loss in decibels through the fiber assuming there are no connectors or splices; **[1 mark]**

ii. The signal attenuation per kilometer for the fiber. **[1 mark]**

iii. The overall signal attenuation for a 10 km optical link using the same fiber with splices at 1 km intervals, each giving an attenuation of 1dB; **[1 mark]**

iv. The numerical input/output ratio in (iii) **[1 mark]**

b. Sketch and name various losses that have contributed to the total fiber loss curve shown in Figure 1. **[6 marks]**

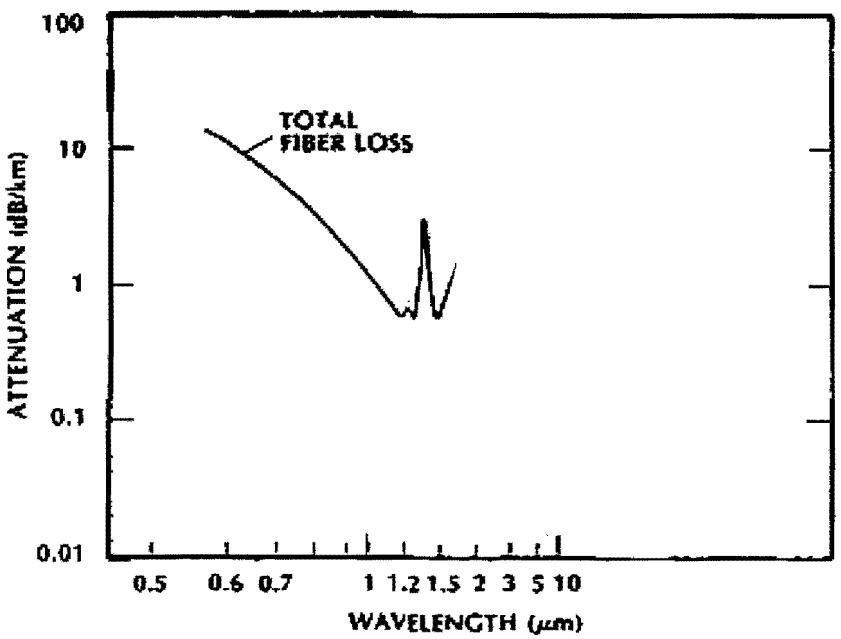

Figure 1

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FAKULTI KEJURUTERAAN

(Faculty of Engineering)

Gelombang Mikro & Teknologi Antenna

(Microwave & Antenna Technology)

KNT 4053

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	19 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	2.00 p.m – 5.00 p.m
Tempat *(Place)*	:	BS 23	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Kismet Anak Hong Ping			

Arahan *(Instruction)* :

1. **Jawab semua soalan di Bahagian A dan TIGA (3) di Bahagian B**
   (Answer all questions in Section A and THREE (3) questions in Section B)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam kertas jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer sheets provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

SECTION A

INSTRUCTION: Answer ALL questions in this section.

(i) Sketch a block diagram of a basic Microwave System Design. **[5 marks]**

(ii) List down **FIVE** important aspects of the Smith Chart. **[5 marks]**

(iii) With an appropriate diagram, describe how electromagnetic energy from the transmitting source to the antenna, and/or from the antenna to the receiver. **[5 marks]**

(iv) What is the intrinsic impedance in a dielectric medium with a dielectric constant of $\varepsilon_r = 2.33$? **[2 marks]**

(v) The receiving antenna of a microwave relay system has an area of 2 m^2, E = 377 μV/m and H = 1 A/m. Find the impedance, power density, and total power. **[3 marks]**

(vi) Using the antennas on the microwave test bench a microwave communication link is to be designed to work over a distance of 90 km at 9 GHz. The antenna gain of 18 dB will be used for both transmitter and receiver antennas. A 10 MHz bandwidth is required and an acceptable CNR is assumed to be 20 dB. The link must work in rainfall of up to 10 mm/hr, which is estimated (from the graph) at 0.25 dB/km. Atmospheric losses may be assumed to be 0.5 dB and the pointing loss is 0.1 dB.

The receiver has an antenna with a noise temperature of 280K, which is fed to the receiver circuitry via a cable with 0.2 dB loss. The receiver has a noise factor of 8 dB. Assume that the background temperature is 290K. Boltzman's constant may be taken as 228.6 dB.

Find the power transmit, P_t. If the rainfall rises to 20 mm/hr at 0.8 dB/km, what does the CNR become? A blank microwave link budget (***APPENDIX A***) is given overleaf as a prompt for the budget calculation.

State clearly your comment(s) on the link quality and make any recommendation(s) you see fit. **[10 marks]**

SECTION B

INSTRUCTION: Choose and answer THREE (3) questions ONLY in this section.

QUESTION 1

(a) State the **TWO** problems prevent conventional electronic equipment from working at the very high frequency. **[2 marks]**

(b) Explain how voltage standing waves are formed. **[4 marks]**

(c) How does skin depth relate to frequency of operation? **[4 marks]**

(d) Referring to ***APPENDIX B***, determine the line width and guide wavelength for a 50Ω microstrip line on 0.025 inch thick alumina ($\varepsilon = 9.6$) at 10GHz. **[4 marks]**

(e) A lossless transmission line with characteristic impedance of 300 ohm is fed by a generator of voltage $\angle 0°$ volts and impedance 100 ohm. The line is 100 m long and is terminated by a resistive load of 200 ohm. Calculate the load reflection coefficient, reflection loss and return loss. **[6 marks]**

QUESTION 2

(a) What is the purpose of terminations/loads? **[2 marks]**

(b) List **FOUR** methods can be used for impedance matching. Why impedance matching so important? **[6 marks]**

(c) Calculate the noise from a resistor when a receiver bandwidth is 10kHz and the resistor temperature is 300° K . **[2 marks]**

(d) The signal at the input of an amplifier has an S/N of 40dB. If the amplifier has a noise figure of 6dB, what is the S/N at the output? **[2 marks]**

(e) What happens to the wire at high RF/Microwave frequencies? Based on the material you have learned, propose a solution in order to make the communication possible. State clearly all assumptions that you make and that are likely to impact the solution you propose. **[8 marks]**

QUESTION 3

(a) What is the main function of an antenna? State **TWO** important parameters for an antenna. **[4 marks]**

(b) How to create radiation? **[2 marks]**

(c) What happens if a voltage source connected to a two-conductor transmission line which is connected to an antenna? **[6 marks]**

(d) Find the number of square degrees in the solid angle Ω on a spherical surface based on the following parameters:
Between $\theta = 40°$ and $\theta = 60°$
Between $\phi = 40°$ and $\phi = 80°$. **[4 marks]**

(e) Calculate the approximate directivity from the half-power beam widths of a unidirectional antenna if the normalized power pattern. In all cases these patterns are unidirectional (+z direction) with P_n having a value only for zenith angles $0° \le \theta \le 90°$ and $P_n = 0$ for $90° \le \theta \le 180°$. The patterns are independent of the azimuth angle ϕ.

(i) $P_n = \cos\theta$ **[2 marks]**
(ii) $P_n = \cos^2\theta$ **[2 marks]**

QUESTION 4

(a) (i) Estimate the directivity of an antenna with $\theta_{HP} = 2°$, $\phi_{HP} = 1°$ **[2 marks]**
(ii) Find the gain of this antenna if efficiency $k = 0.5$. **[2 marks]**

(b) What is the required diameter of a conical horn antenna operating at 3 GHz with 14 dBi gain? **[3 marks]**

(c) Discuss on polarization by stating the general characteristics and state clearly the *necessary and sufficient* condition in order to posses the THREE polarizations. **[9 marks]**

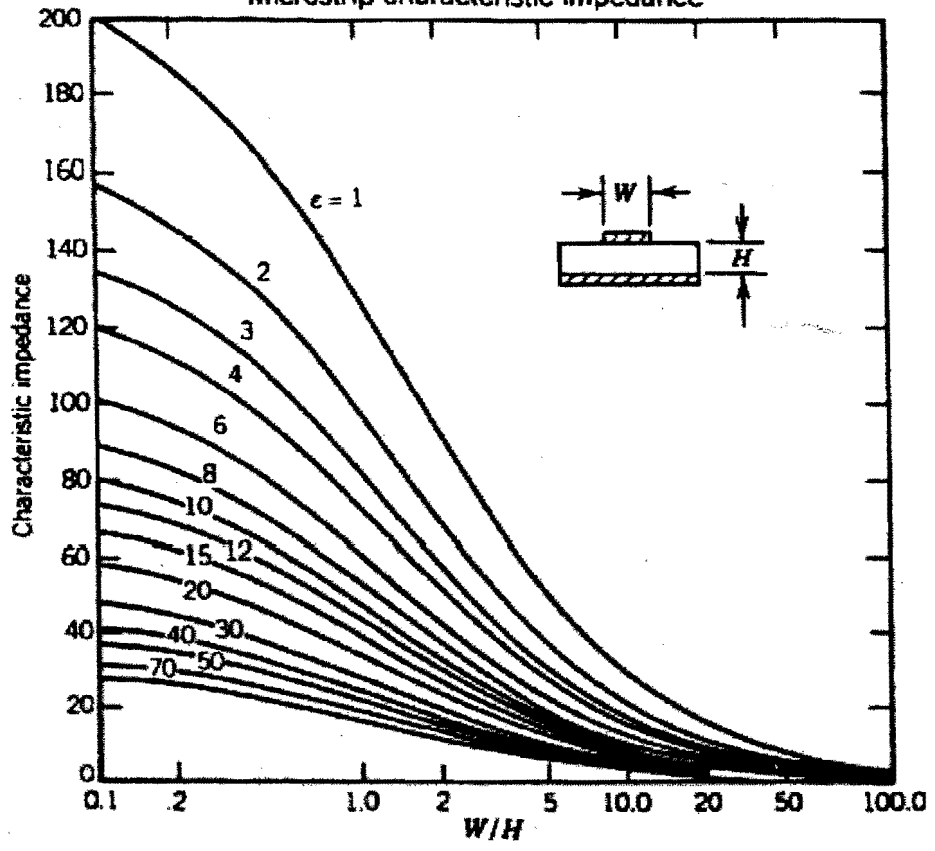
(d) Describe a helix antenna. What is its advantage? What type of wave propagation is involved? **[4 marks]**

APPENDIX A

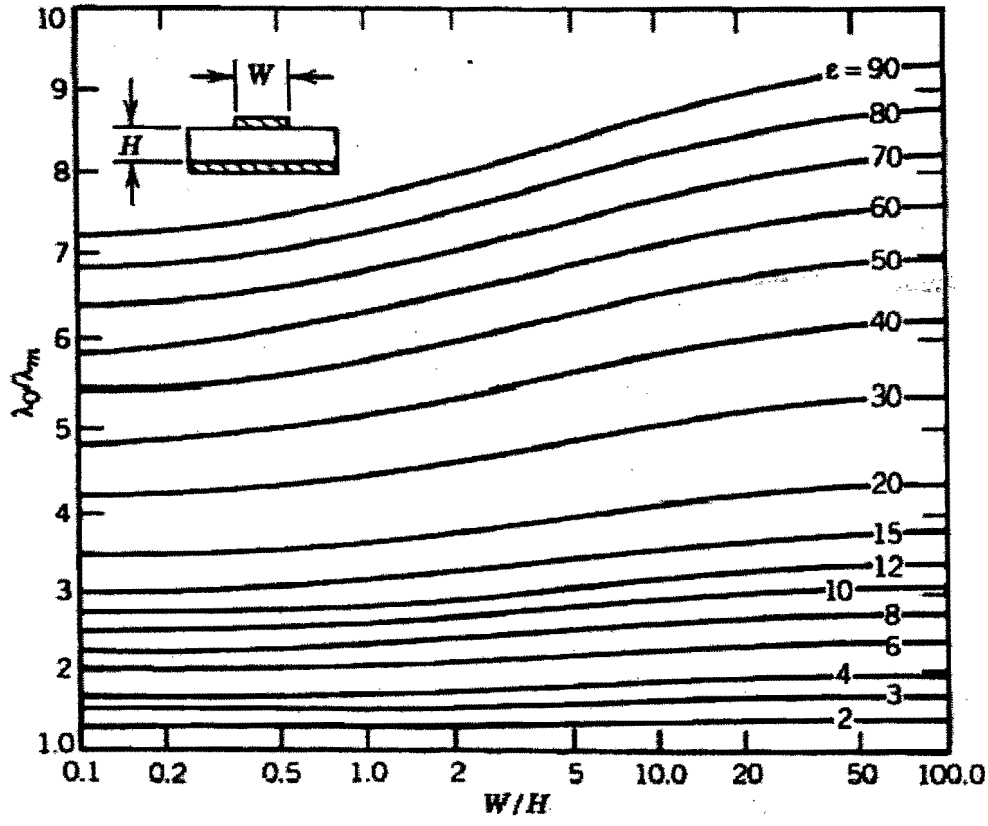
Frequency	
Transmit Power	P_t
Transmit Antenna Gain	g_t
	EIRP
Path Length	
Propagation Loss	L_p
Atmospheric Loss	L_a
Rain Loss	
Polarisation Loss	
Pointing Loss	
Receive Antenna Gain	g_r
Background Noise	T_b
Receiver Noise Figure	F
Receiver Noise Temperature	T_{eq}
Receiver g/T	
Boltzmann constant	K
Bandwidth	B
Headroom	
CNR	

APPENDIX B

Microstrip characteristic impedance



Ratio of free space wavelength (λ_0) to microstrip wavelength (λ_m)



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SARAWAK

FAKULTI KEJURUTERAAN

(Faculty of Engineering)

PENGANTARAMUKA MIKROKOMPUTER

(Microcomputer Iterfacing)

KNK4063

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	14 Oktober 2004
Semester	:	Semester1 Sesi 2004/2005	**Masa** *(Time)*	:	9.00 am – 12.00 pm
Tempat *(Place)*	:	Bilik Seminar 23	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Martin Anyi			

Arahan *(Instruction)* :

1. **Jawab lima (5) soalan sahaja.**
   (Answer five questions only)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

Question 1

(a) List and explain the three criteria in choosing a microcontroller. **[6 marks]**

(b) If you choose to use the 8051 family, explain your reasons based on the criteria you have explained in (a). **[4 marks]**

Question 2

(a) Explain the effects of resetting the 8051 microcontroller. **[6 marks]**

(b) Figure 1 shows the reset circuitry of the 8051 microcontroller. Explain what is/are the functions of the 10 uF capacitor and the 8.2 K resistor used in the diagram. **[4 marks]**

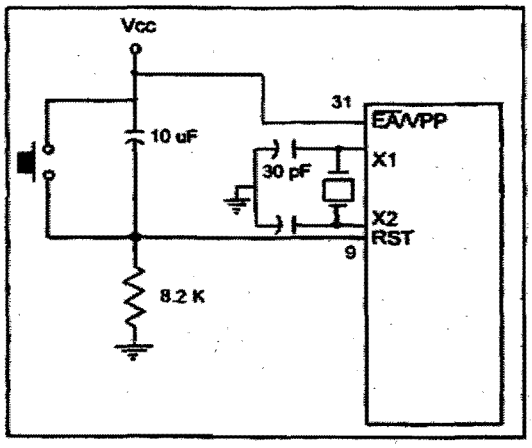

Figure 1

Question 3

(a) Single bit operation is a unique feature of the 8051 microcontroller. Explain what is single bit operation used in 8051 microcontroller. **[4 marks]**

(b) List three (3) single bit commands used in 8051 microcontroller and write a single line program (with comment) for each of the command that you have listed. **[6 marks]**

Question 4

(a) An 8 bit data need to be fetched from Port 0. The data fetched must be send immediately to a set of LEDs connected to pin P1.0, P1.1, P1.2, P1.3, P1.4, P1.5, P1.6, P1.7 of the 8051 microcontroller. Draw the block diagram of your system, clearly showing all necessary components connections and explain your diagram briefly. **[6 marks]**

(b) Write a program (with comments) for (a) above. **[4 marks]**

Question 5

(a) Based on Figure 2, Find the value for TMOD if we want to program timer 0 in mode2, use 8051 XTAL for the clock source, and use instructions to start and stop the timer. **[6 marks]**

(MSB) (LSB)

GATE	C/T	M1	M0	GATE	C/T	M1	M0
Timer 1				Timer 0			

GATE Gating control when set. Timer/counter is enabled only while the INTx pin is high and the TRx control pin is set. When cleared, the timer is enabled whenever the TRx control bit is set.
C/T Timer or counter selected cleared for timer operation (input from internal system clock). Set for counter operation (input from Tx input pin).
M1 Mode bit 1
M0 Mode bit 0

M1	M0	Mode	Operating Mode
0	0	0	13-bit timer mode 8-bit timer/counter THx with TLx as 5-bit prescaler
0	1	1	16-bit timer mode 16-bit timer/counters THx and TLx are cascaded; there is no prescalar
1	0	2	8-bit auto reload 8-bit auto reload timer/counter; THx holds a value which is to be reloaded into TLx each time it overflows.
1	1	3	Split timer mode

Figure 2

(b) Indicate which mode and timer are selected for each of the following.

i. MOV TMOD, #12H **[1 marks]**

ii. MOV TMOD, #20H **[1 marks]**

iii. MOV TMOD, #32 **[1 marks]**

iv. MOV TMOD, #01 **[1 marks]**

Question 6

(a) Figure 3 shows the timing diagram for ADC0804 (analog to digital converter) operation. Based on the diagram given, explain all necessary steps taken in order for the 8051 to read the data pins of the ADC0804. **[6 marks]**

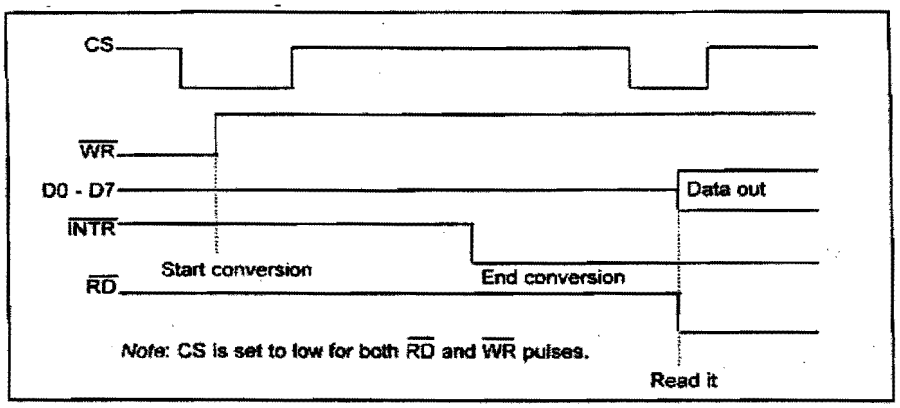

Figure 2

(b) Draw and explain the block diagram of the system used in (a) **[4 marks]**

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SARAWAK

FAKULTI KEJURUTERAAN
(Faculty of Engineering)

Rekabentuk Sistem Terbenam
(Embedded System Design)

KNK 4083

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	19 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	2.00 pm – 5.00 pm
Tempat *(Place)*	:	Bilik Seminar 23	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	En. Ng Liang Yew / En. John Lio Siang Peng			

Arahan *(Instruction)* :

1. **Jawab semua soalan di Bahagian A dan SATU (1) soalan di Bahagian B.**
   (Answer all questions in Section A and ONE (1) questions in Section B)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

Section A (Answer all questions)

Question 1.

a. Company X has produced Product Z with a unit cost of RM 1,000.00 per unit. The main component in Product Z is the general processor. The reason for choosing the general processor is because they wanted to penetrate the market earlier than their competitors. Assume that the time to market is 8 month, the product lifetime is 200-month and the peak revenue is RM 1,000,000.00. After successfully introducing the product, the managing director decides to further reduce the cost of the product to increase profit. As an engineer, you have to decide on **which processor to adopt to run your Product Z** and **justify your choices by calculating the total profit gained.** The details costing of different processors can be found in *Table 1.1*.

Processor	Time to market, Month	NRE, RM	Unit Cost, RM	Profit, RM
Single Purpose	15	200,000.00	600.00	900.00
Application Specific	12	150,000.00	800.00	700.00

Table 1.1

[10 Marks]

b. Design a counter that can count in the following order:

0, 2, 4, 2, 6, 2, 0, 2, 4, 2, 6, ...

[10 Marks]

Question 2.

a. Describe briefly what is a Watchdog Timer and how it benefits the system.

[4 Marks]

b. *Figure 2.1* is the schematic diagram of a Prescaler. Draw the waveform of input (Clock) and the output (Output [3..0])

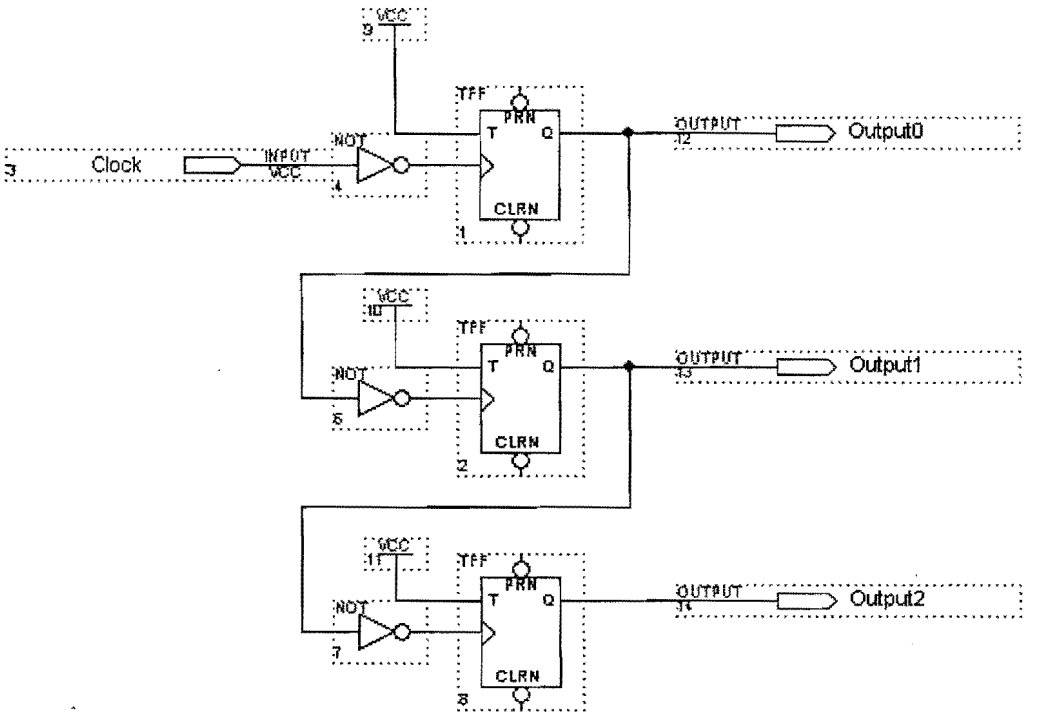

Figure 2.1

[8 Marks]

c. Based on the Prescaler schematic in *Figure 2.1*, assume that the "Clock" for the Prescaler is 5 kHz and "Output 2" is connected to the "Clock" of a 16-bit counter. What is the inertial value of the counter if the "Top" of the counter asserts every 1-minute?

[8 Marks]

Question 3.

a. Discuss briefly the functionality of the following terms: -

i. Logic synthesis tools, **[1 Mark]**

ii. Register-transfer synthesis tools, **[1 Mark]**

iii. Soft Core, and **[1 Mark]**

iv. Hard Core. **[1 Mark]**

b. What are the advantages and disadvantages of the Simulation Verification Process (E.g. Instruction-set Simulator) compared to the Physical Verification Process (E.g. Emulators)?

[8 Marks]

c. Describe briefly in your own words about **design process models**. Include **sketches to aid your description.**

[8 Marks]

Question 4.

a. Explain briefly why increasing the cache size can sometimes disrupt the performance of the whole micro processing system in general. What are two commonly used methods to improve hit rate without increasing the cache size?

[3 Marks]

b. Describe briefly the differences and the application for both SRAM and DRAM.

[5 Marks]

c. *Figure 4.1* shows the block diagram of a basic ROM. If the size of the ROM is 2 MB, how many addressing pins should the ROM have?

[4 Marks]

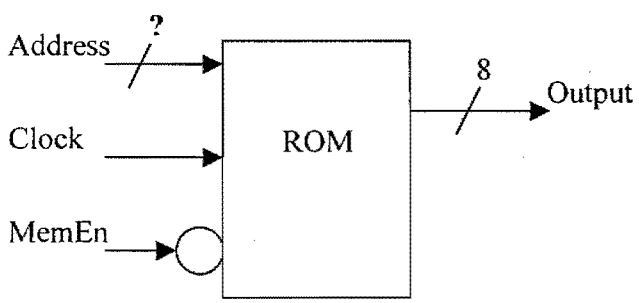

Figure 4.1

d. By using the 2^4x4 ROMs, design a FSM that can count in the following order: -

0, 1, 4, 2, 6, 3, 8, 4, 10, 5, 12, 6, 14, 7, 0, 1, 4, 2, ...

Include the **schematic drawing** of the design followed by **the contains ROMs used.** The contains of both ROMs should be presented in the form of **Truth Table format (Address and Data).**

[8 Marks]

Section B (Answer only 1 question)

Question 1.

a. Compose a complete VHDL code for the 8-bit counter. *Figure 1.b.1* is the block diagram of the 8-bit Counter. Refer to *Table 1.b.1* for the truth table for the counter.

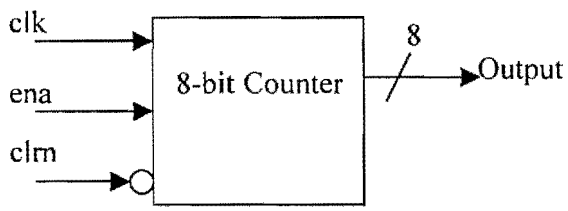

Figure 1.b.1

Input	Output
00000000	00000001
00000001	00000010
00000010	00000100
00000100	00001000
00001000	00010000
00010000	00100000
00100000	01000000
01000000	10000000
10000000	00000000

Table 1.b.1

[12 Marks]

b. Sketch the output of the 8-bit counter in Question 1.a. according to given input signals. Refer to Figure 1.b.2. Assume that the **system is ideal** and there is **no time delay.**

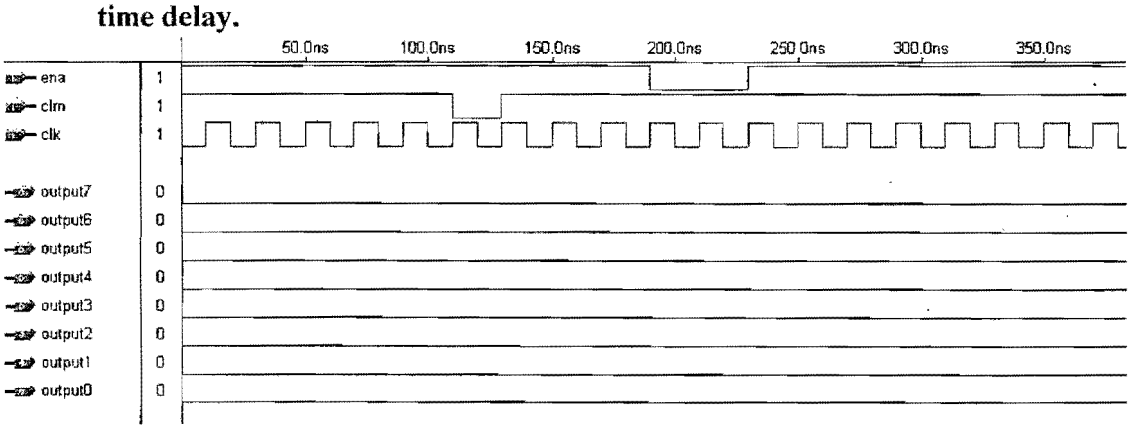

Figure 1.b.2

[8 Marks]

Question 2.

Figure 2.b.1 shows the block diagram of a car and it's controller unit. The front of the car is attached with a sensor to detect collision. Upon detection, the sensor will give an output of '1'. The car will only start when the Start input is asserted and stop when deasserted. To move forward and left (90°), assert the respective output. The car is required to move in a route specified in *Figure 2.b.2*. Design the FSM Controller Unit of the car by using logic gates. The design must also include the following: -

a. Flow chart of the controller, **[4 Marks]**

b. Truth table, **[4 Marks]**

c. Boolean equation derived from the truth table, and **[8 Marks]**

d. Schematic connections. **[4 Marks]**

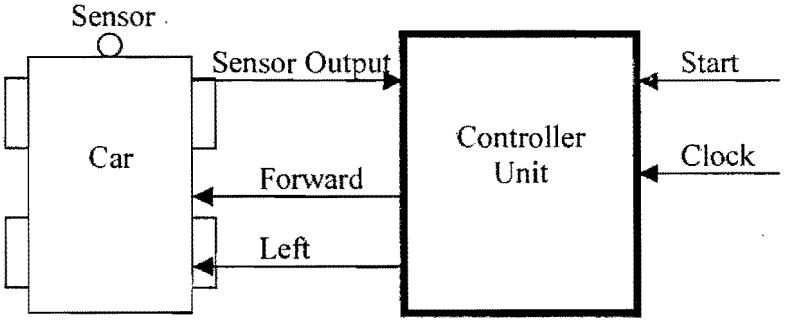

Figure 2.b.1

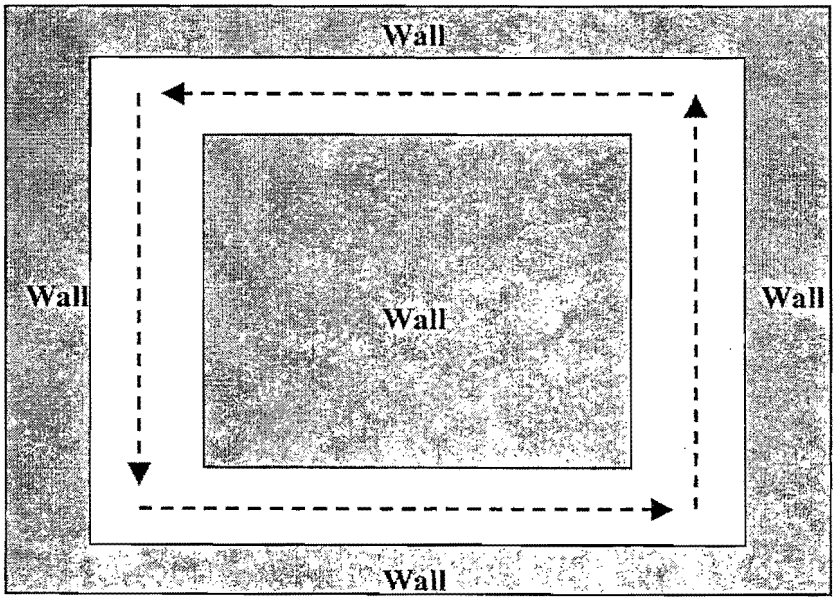

Figure 2.b.2

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FAKULTI KEJURUTERAAN
(Faculty of Engineering)

Pemprograman Imej / Grafik
(Graphic / Image Processing)

KNK 3113/3023

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	22 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	9.00 am – 12.00 pm
Tempat *(Place)*	:	BS 11	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Kismet Anak Hong Ping			

Arahan *(Instruction)* :

1. **Jawab semua soalan di Bahagian A dan TIGA (3) di Bahagian B.**
   (Answer all questions in Section A and Three (3) question in Section B)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

SECTION A

(i) Describe a ***digital image.*** **[2 marks]**

(ii) What is the difference between human perception and machine perception? **[2 marks]**

(iii) Consider the image segment.

$$\begin{matrix} 3 & 1 & 2 & 1\,(q) \\ 2 & 2 & 0 & 2 \\ 1 & 2 & 1 & 1 \\ (p)\,1 & 0 & 1 & 2 \end{matrix}$$

Let V={1,2} and compute the lengths of the shortest 4-,8- and m-path between p and q. If a particular path does not exist between these two points. Explain why. **[6 marks]**

(iv) Given a source which generates one of six possible symbols

$$A = \{a_1, a_2, a_3, a_4, a_5, a_6\}$$

with corresponding probabilities

$$\{0.1,\ 0.4,\ 0.06,\ 0.1,\ 0.04,\ 0.3\}.$$

Apply Huffman code assignment procedure.

What is the average length of this code?

What is the Entropy of the source?

What is the decoded code if given the encoded string

$$\mathbf{010100111100}_2.$$ **[10 marks]**

SECTION B

Instruction: ANSWER **THREE (3)** QUESTIONS ONLY

QUESTION 1

(a) Define the purpose of the point processing and mask processing techniques. **[4 marks]**

(b) Sketch a diagram and describe in detail the general procedure to apply a frequency domain filter to an input image. **[8 marks]**

(c) List THREE types of frequency based sharpening filters and explain their differences. **[3 marks]**

(d) (i) Give a continuous function for implementing the contrast stretching transformation shown in Figure 1. In addition to m, your function must include a parameter, E, for controlling the slope of the function as it transitions from low to high gray-level values. Your function should be normalised so that its minimum and maximum values are 0 and 1, respectively. **[2 marks]**

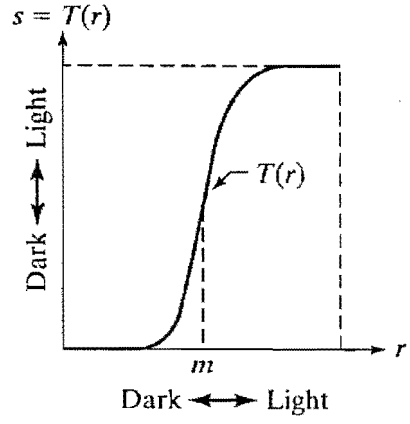

Figure 1

(ii) Sketch a family of transformations as a function of parameter, E, for a fixed value $m = L/2$, where L is the number of gray levels in the image. **[3 marks]**

QUESTION 2

(a) What is the purpose of using mathematical morphology? **[2 marks]**

(b) Briefly explain the Dilation and Erosion technique in morphological image processing operations. State the Image Processing Toolbox (IPT) function for each of them. **[6 marks]**

(c) Sketch a matrix order of ***Prewitt*** and ***Sobel*** masks for detecting diagonal edges. **[2 marks]**

(d) Suppose that we had used the edge model shown in Figure 2, instead of the ramp model of an edge. Sketch the gradient and Laplacian of the first- and second-derivative. **[4 marks]**

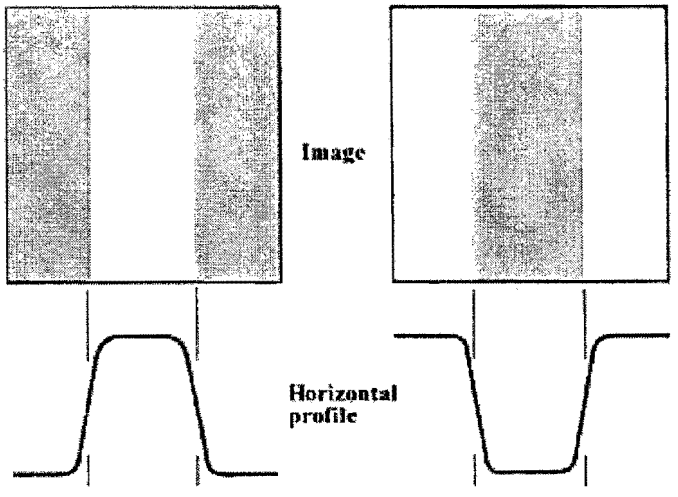

Figure 2

(e) The speed of a bullet in flight is to be estimated by using high-speed imaging techniques. The method of choice involves the use of a TV camera and flash the exposes the scene for K s. The bullet is 2.5 cm long, 1 cm wide, and its range of speed is 750 ± 250 m/s.

Propose a segmentation technique procedure for automatically extracting the bullet from a sequence of frames. **[6 marks]**

QUESTION 3

(a) Explain two processes involved to create a digital image. **[4 marks]**

(b) State the problems and solutions of the Chain Codes and Polygonal Approximations. **[4 marks]**

(c) What is the order of the shape number for the Figure 3. Obtain the shape number (Assume that you start at the top left corner). **[4 marks]**

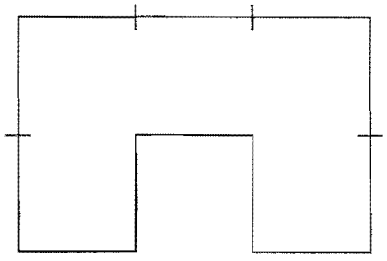

Figure 3.

(d) A company that bottles a variety of industrial chemicals has heard of your success solving imaging problems and hires you to design an approach for detecting when bottles are not full. The bottles appear as shown in Figure 4 as they move along a conveyor line past an automatic filling and capping station. A bottle is considered imperfectly filled when the level of the liquid is below the midway point between the bottom of the neck and the shoulder of the bottle. The shoulder is defined as the region of the bottle where the sides and slanted poring system equipped with an illumination flash front end that effectively stops motion, so you will be given images that look very close to the sample shown here. Based on the material you have learned, propose a solution for detecting bottles that are not filled up properly. State clearly all assumptions that you make and that are likely to impact the solution you propose. **[8 marks]**

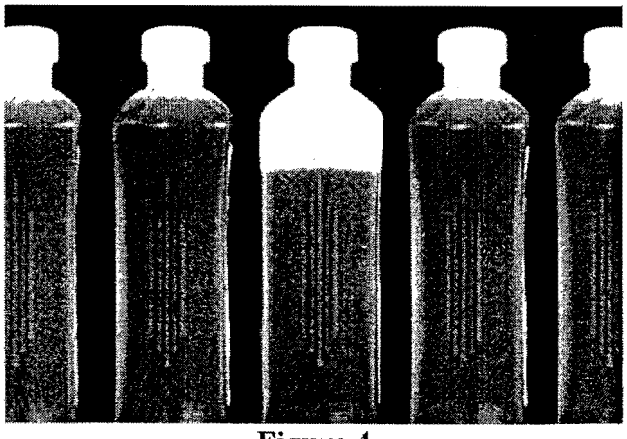

Figure 4

QUESTION 4

(a) Briefly describe the comparison between image restoration and image enhancement. **[6 marks]**

(b) Explain what image compressions do to an image and why this step is important. **[4 marks]**

(c) An archaeology expert doing research on currency exchange practices during the Roman Empire recently became aware that four Roman coins crucial to his research are listed in the holdings of the National Museum in Kuala Lumpur. Unfortunately, he was told after arriving there that the coins recently had been stolen. Further research on his part revealed that the museum keeps photographs of every item. Unfortunately, the photos of the coins in question are blurred to the point where the date and other small marking are not readable. The cause of the blurring was the camera being out of focus when the pictures were taken. As an image processing expert, you are asked as a favour to determine whether the computer processing can be utilized to restore the images to the point where the archaeologist can read the markings. You are told that the original camera used to take the photos is still available, as are other representative coins of the same era. Propose a step-by-step solution to this problem. **[10 marks]**

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SARAWAK

FAKULTI KEJURUTERAAN

(Faculty of Engineering)

PENGANTARAMUKA MIKROKOMPUTER

(Microcomputer Iterfacing)

KNK4063

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	14 Oktober 2004
Semester	:	Semester1 Sesi 2004/2005	**Masa** *(Time)*	:	9.00 am – 12.00 pm
Tempat *(Place)*	:	Bilik Seminar 23	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Martin Anyi			

Arahan *(Instruction)* :

1. **Jawab lima (5) soalan sahaja.**
   (Answer five questions only)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

Question 1

(a) List and explain the three criteria in choosing a microcontroller. **[6 marks]**

(b) If you choose to use the 8051 family, explain your reasons based on the criteria you have explained in (a). **[4 marks]**

Question 2

(a) Explain the effects of resetting the 8051 microcontroller. **[6 marks]**

(b) Figure 1 shows the reset circuitry of the 8051 microcontroller. Explain what is/are the functions of the 10 uF capacitor and the 8.2 K resistor used in the diagram. **[4 marks]**

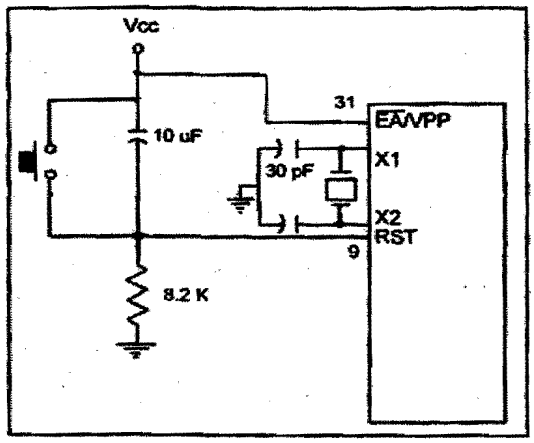

Figure 1

Question 3

(a) Single bit operation is a unique feature of the 8051 microcontroller. Explain what is single bit operation used in 8051 microcontroller. **[4 marks]**

(b) List three (3) single bit commands used in 8051 microcontroller and write a single line program (with comment) for each of the command that you have listed. **[6 marks]**

Question 4

(a) An 8 bit data need to be fetched from Port 0. The data fetched must be send immediately to a set of LEDs connected to pin P1.0, P1.1, P1.2, P1.3, P1.4, P1.5, P1.6, P1.7 of the 8051 microcontroller. Draw the block diagram of your system, clearly showing all necessary components connections and explain your diagram briefly. **[6 marks]**

(b) Write a program (with comments) for (a) above. **[4 marks]**

Question 5

(a) Based on Figure 2, Find the value for TMOD if we want to program timer 0 in mode2, use 8051 XTAL for the clock source, and use instructions to start and stop the timer. **[6 marks]**

(MSB) (LSB)

GATE	C/T	M1	M0	GATE	C/T	M1	M0
Timer 1				Timer 0			

GATE Gating control when set. Timer/counter is enabled only while the INTx pin is high and the TRx control pin is set. When cleared, the timer is enabled whenever the TRx control bit is set.
C/T Timer or counter selected cleared for timer operation (input from internal system clock). Set for counter operation (input from Tx input pin).
M1 Mode bit 1
M0 Mode bit 0

M1	M0	Mode	Operating Mode
0	0	0	13-bit timer mode 8-bit timer/counter THx with TLx as 5-bit prescaler
0	1	1	16-bit timer mode 16-bit timer/counters THx and TLx are cascaded; there is no prescalar
1	0	2	8-bit auto reload 8-bit auto reload timer/counter; THx holds a value which is to be reloaded into TLx each time it overflows.
1	1	3	Split timer mode

Figure 2

(b) Indicate which mode and timer are selected for each of the following.

i. MOV TMOD, #12H **[1 marks]**

ii. MOV TMOD, #20H **[1 marks]**

iii. MOV TMOD, #32 **[1 marks]**

iv. MOV TMOD, #01 **[1 marks]**

Question 6

(a) Figure 3 shows the timing diagram for ADC0804 (analog to digital converter) operation. Based on the diagram given, explain all necessary steps taken in order for the 8051 to read the data pins of the ADC0804. **[6 marks]**

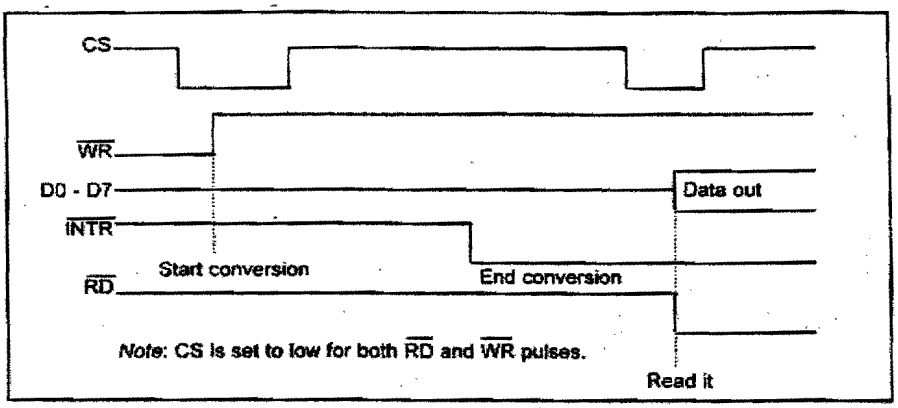

Figure 2

(b) Draw and explain the block diagram of the system used in (a) **[4 marks]**

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SARAWAK

FAKULTI KEJURUTERAAN
(Faculty of Engineering)

Teknologi Kejuruteraan Elektrik
(Electrical Engineering Technology)

KNL 1233

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	19 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	9.00 am – 12.00 pm
Tempat *(Place)*	:	Bilik Seminar 23	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	En. Thelaha Masri			

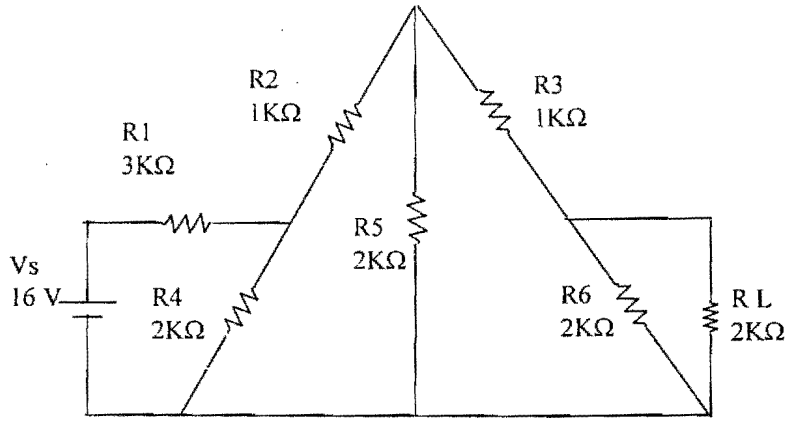
Arahan *(Instruction)* :

1. **Jawab LIMA (5) soalan sahaja.**
   (Answer FIVE (5) questions only)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

Answer **FIVE (5)** questions only

Question 1

(a) For the circuit below, find the total Conductance, G_T.



[5 marks]

(b) Find the capacitance, C, of a capacitor with a voltage drop of 30 V and a charge of 6 Coulombs.

[4marks]

(c) What is the mutual inductance when $k = 0.75$, $L_1 = 1\mu H$, and $L_2 = 4\mu H$?

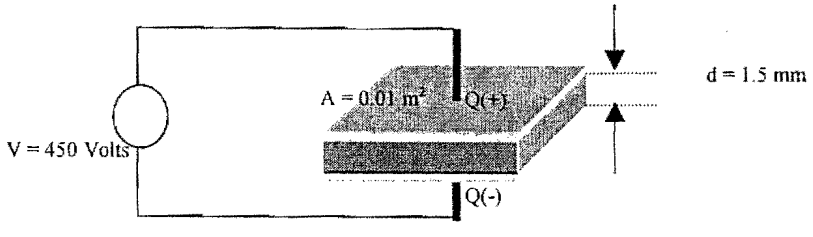
[5 marks]

(d) A sheet of mica (dielectric constant of 5.0) 1.5 mm thick having the area of 0.01 m^2, is inserted between the plate shown in the diagram below.

i. Find the electric field strength between the plates. **[2 marks]**

ii. Find the charge on each plate. **[2 marks]**

iii. Find the capacitance. **[2 marks]**



Question 2

(a) List and explain briefly five factors that affect the inductance of a coil. Sketch diagrams to support your ideas.

[15 marks]

(b) What is the total amount of reactance (X) in a series circuit which contains an X_L of 20 ohms and an X_C of 50 ohms? (Indicate whether X is capacitive or inductive)

[5 marks]

Question 3

(a) In an AC circuit, explain what is;

i. True power

ii. Reactive power

iii. Apparent power

iv. Power factor

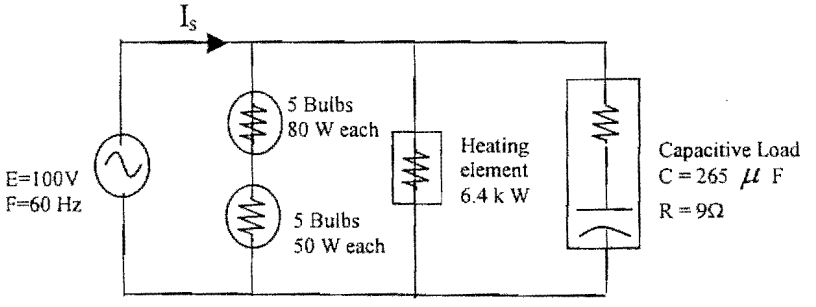
[4 marks]

(b) For the circuit given below,

i. Find the average power, apparent power, reactive power and its power factor at each branch. **[6 marks]**

ii. Find the total number of watts, voltage –amperes reactive and voltage-ampere and the power factor of the system, and **[6 marks]**

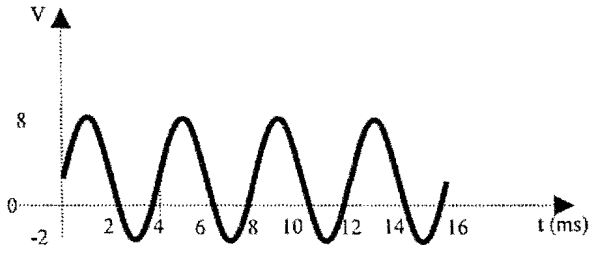
iii. Find the value of the source current, I_s. **[4 marks]**



Question 4

(a) Using a suitable diagram, draw and describes the differences between an AC Voltage generator and a DC Voltage Generator. **[10 marks]**

(b) For the sine wave shown below, find the following values. Show your workouts.



i. Average ($V_{dc} = V_{ave}$)

ii. Peak ($V_p = V_{max}$)

iii. Peak to peak (V_{pp})

iv. Minimum (V_{min})

v. RMS of the AC only (V_{rms})

vi. RMS of the total signal (V_{rms})

vii. Frequency = f

viii. Period = T

[8 marks]

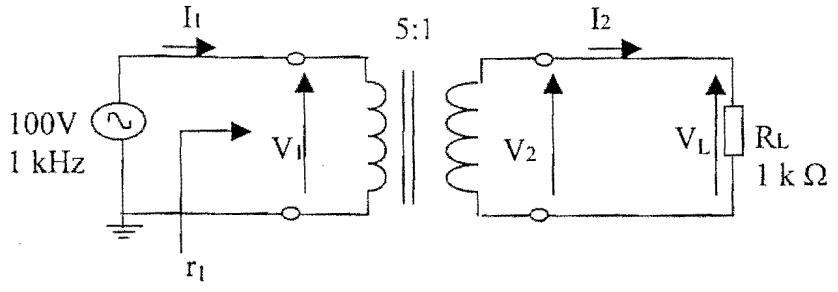
(c) Is the wave (in the diagram) an alternating or non-alternating wave? Explain why. **[2 marks]**

Question 5

(a) Describe how a transformer is constructed and how it operates. **[3 marks]**

(b) Calculate the core area required for a 1600KVA, 6000/440 V, 50 Hz, single-phase core type power transformer. Assume that a maximum flux density of 1.2 Wb/m^2 and an induced voltage per turn is 30 Volts. **[5 marks]**

(c) An Ideal Transformer



From the diagram above, find;

i. V_1 and V_2

ii. V_L and I_2

iii. I_1

iv. AC primary reflected resistance, r_1.

[12 marks]

Question 6

(a) What is Hysteresis and illustrate the development of the hysteresis curve.

[8 marks]

(b) A single phase transformer has 400 primary and 1000 secondary turns. The net cross sectional area of the core is 60 cm^2. If the primary is connected to 500 V, 50 Hz source,

i. Find the peak value of flux density in the core

ii. Calculate the voltage induced in the secondary.

8 marks]

(c) Explain the purpose of impedance matching. Give an example and sketch a diagram to support your idea.

[4 marks]

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FAKULTI KEJURUTERAAN
(Faculty of Engineering)

Pemprograman Berstruktur
(Structured Programming)

KNL 1353

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	12 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	2.00 pm – 5.00 pm
Tempat *(Place)*	:	Bilik Seminar 11	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	En. Hushairi Zen			

Arahan *(Instruction)* :

1. **Jawab semua soalan.**
   (Answer all questions)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

Question 1

Construct a logical expression to represent each of the following conditions:

a. *score* is greater than or equal to 80 but less than 90;

b. *answer* is either 'N' or 'n';

c. *n* is even but not 8;

d. *ch* is a capital letter.

[16 marks]

Question 2

For question 2 refer to Listing 1.0 in **Appendix A.**

Write down the output of listing 1.0 if the user enters side as 5.

[20 marks]

Question 3

Write a program that calculates parallel and serial value of resistors. Your program must have *functions prototype*, *functions calling* and *functions definition.*

Use *functions overloading* for more than 2 resistors. Add comments to make your source code clear.

[20 marks]

Question 4

The program in listing 1.1 below displays on the screen a solid square of asterisks whose side is specified in integer parameter **side.** For example, if **side** is 4, the function displays

```
* * * *
* * * *
* * * *
* * * *
```

Complete the program in listing 1.1 by writing the missing source code. Add important comments to the source code.

```
//Listing 1.1

include <iostream.h>

void square (int);

int main ( )
{
int side;
cout<< "Enter side :" ;
cin >> side;
cout<< "\n" ;
square (side);
cout << endl;
return 0;
}
```

[20 marks]

Question 5

Explain the meaning of the following words:

a. local variables

b. function overloading

c. polymorphism

[12 marks]

Question 6

When should global variables be used? Write a short source code that shows the different between a local variables and a global variables

[12 marks]

APPENDIX A

// Listing 1.0 for question 2.

```
#include <iostream.h>

int main()
{
  for ( int row = 1; row <= 10; ++row ) {

    for ( int col = 1; col <= row; ++col )
      cout << '*';

    cout << '\n';
  }

  cout << '\n';

  for ( row = 10; row >= 1; --row ) {

    for ( int col = 1; col <= row; ++col )
      cout << '*';

    cout << '\n';
  }

  cout << '\n';

  for ( row = 10; row >= 1; --row ) {

    for ( int space = 1; space <= 10 - row; ++space )
      cout << ' ';

    for ( int col = 1; col <= row; ++col )
      cout << '*';

    cout << '\n';
  }

  cout << '\n';


  return 0;
}
```

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FAKULTI KEJURUTERAAN
(Faculty of Engineering)

Kejuruteraan Perisian
(Software Engineering)

KNL 2363 / KNL 2113

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	13 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	9.00 am – 12.00 pm
Tempat *(Place)*	:	Bilik Seminar 11	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	En. Hushairi Zen			

Arahan *(Instruction)* :

1. **Jawab semua soalan.**
   (Answer all questions)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

Question 1

Write the prototype and the definition for a function named **Perimeter**, which returns an *unsigned long int* and which takes two parameters, both *unsigned short ints.*

Two parameters represent the *length* and *width* of the rectangle and have the function return the perimeter (twice the length plus twice the width).

[10 marks]

Question 2

Identify the error/s in the following source code. Rewrite the program so that there is no error/s.

```
#include <iostream.h>

void myFunc(unsigned short int x);
int main()
{
unsigned short int x, y;
y = myFunc(int);
cout << "x: " << x << " y: " << y << "\n";
return 0;
}

void myFunc(unsigned short int x)
{
return (4*x);
}
```

[10 marks]

Question 3

Write a class Employee that has three data members: *age, yearsOf Service*, and *Salary.* Include public accessor methods to get and set each of the data members. Write a driver program that creates two objects of employees, sets their *age, yearsOfService* and *salary* and prints their values.

[20 marks]

Question 4

Identify 3 major errors in the following program and describe the errors.

```
class  TV
{
public:
   void SetStation(int Station);
   int GetStation() const;
private:
   int itsStation;
};

main()
{
   TV myTV;
   myTV.itsStation = 9;
   TV.SetStation(10);
   TV myOtherTv(2);
}
```

[15 marks]

Question 5

Write a program that declares an **int**, a reference to an **int**, and a pointer to an **int**.

Use the pointer and the reference to manipulate the value in the int.

[10 marks]

Question 6

Answer each question according to the requirements.

i. Write a *SimpleCircle* class declaration with one member variable: *itsRadius.* Include a default constructor, a destructor, and accessor methods for *itsRadius.*

[4 marks]

ii. Write the implementation of the default constructor, initializing *itsRadius* with the value 5.

[4 marks]

iii. Using the same class, add a second constructor that takes a value as its parameter and assigns that value to *itsRadius.*

[4 marks]

iv. Create a prefix and postfix increment operator for your *SimpleCircle* class that increments *itsRadius.*

[4 marks]

v. Change *SimpleCircle* to store *itsRadius* on the free store, and fix the existing methods that you have done in questions 1 to 4.

[6 marks]

vi. Provide a copy constructor for SimpleCircle.

[4 marks]

vii. Provide an operator= for SimpleCircle.

[4 marks]

viii. Write a program that creates two SimpleCircle objects.

Use the default constructor on one and instantiate the other with the value 9. Call increment on each and then print their values. Finally, assign the second to the first and print its values.

[5 marks]

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FAKULTI KEJURUTERAAN
(Faculty of Engineering)

LITAR ELEKTRONIK
(Electronic Circuits)

KNL 2383

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	11 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	2.00 p.m – 5.00 p.m
Tempat *(Place)*	:	BS 11	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Cik Nordiana Rajaee			

Arahan *(Instruction)* :

1. **Jawab SEMUA soalan Bahagian A dan SATU soalan Bahagian B.**
   (Answer ALL questions in Section A and ONE question in Section B)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

SECTION A: Answer ALL questions

QUESTION 1

(a) The circuit in Figure 1 is a comparator circuit. Describe how a comparator circuit works and determine the reference voltage for the comparator.

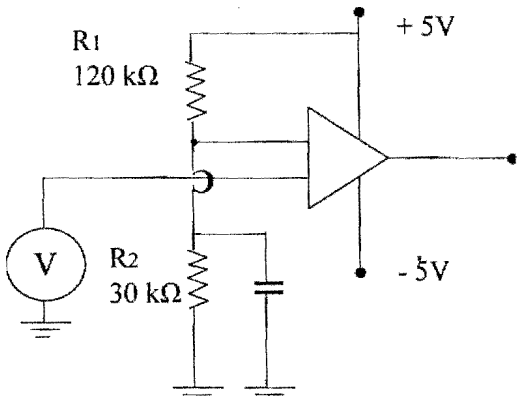
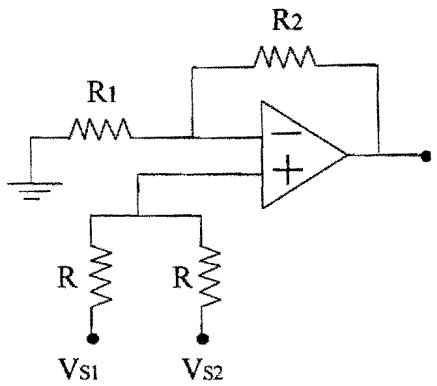


Figure 1 **[6 marks]**

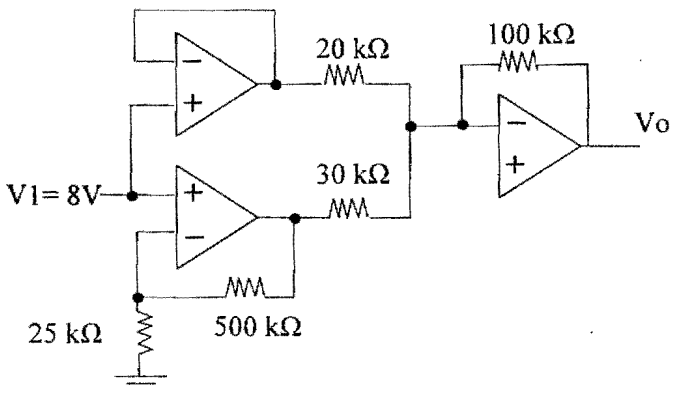
(b) Assume the op-amp in Figure 2 is ideal. Find the expression for output v_o of the amplifier circuit and what mathematical operation does the circuit perform?



[9 marks]

Figure 2

(c) Determine the output voltage in the circuit shown in Figure 3.



[5 marks]

Figure 3

QUESTION 2

(a) A voltage amplifier circuit with source voltage of 10mV has 20Ω of source resistance. The input impedance of the circuit is 980Ω and its output impedance is 80Ω. If the load resistance of the output circuit is 900Ω and the gain is 2, determine the loss (reduction) of the output voltage.

[3 marks]

(b) The term 'op-amp' was originally used to describe a chain of high performance dc amplifiers.

(i) Show a connection of a quad-op amp as a three-stage-amplifier with respective gains of 5, -10 and -20. Using a feedback resistor of 300kΩ in all stages, calculate the output voltage if the input voltage is 150μV. **[3 marks]**

(ii) Consider the resistors and feedback resistor used in section (i) and apply it to a connection of three individual inverting op-amps in parallel stages. Assuming the input voltage is 150μV, sketch this circuit diagram and determine the output voltages with respect to the three op-amps.

[4 marks]

(c) State the differences in operating cycles and power efficiencies for Class A, Class B, Class C and Class D power amplifiers.

[4 marks]

(d) The Common-Mode-Rejection-Ratio represents the ratio of differential gain over common gain. If the CMRR for an op-amp increases, how does it affect the relationship between the output voltage and difference input times difference gain?

[6 marks]

QUESTION 3

(a) Sketch basic layout of a Phase-Locked-Loop and briefly explain its operating modes.

[8 marks]

(b) A voltage-controlled-oscillator (VCO) is a circuit that provides a varying output signal of square-wave or triangular-wave, whose frequency can be adjusted over a range controlled by dc voltage. Figure 4 shows a 566 connection as a VCO.

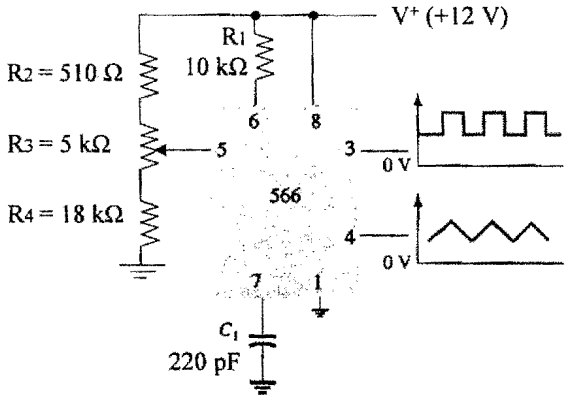


Figure 4

(i) For a practical circuit connection, what are the circuit value restrictions?

[4 marks]

(ii) If R_3 does not exist, calculate the free running or center-operating frequency) of the circuit.

[2 marks]

(iii) If R_3 does exist and is a potentiometer, then it can be replaced with an ac voltage. Based on your calculations, what is the peak value for the ac input voltage?

[6 marks]

SECTION B: Answer ONE question only

QUESTION 1

Figure 5 shows basic circuitry for a Timer IC and a 555 Astable Timer. Describe the operation of the 555 Astable Timer.

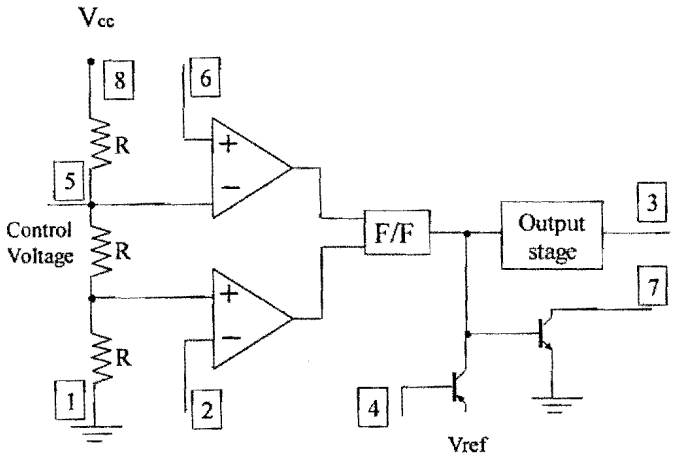


Figure 5a: Timer IC

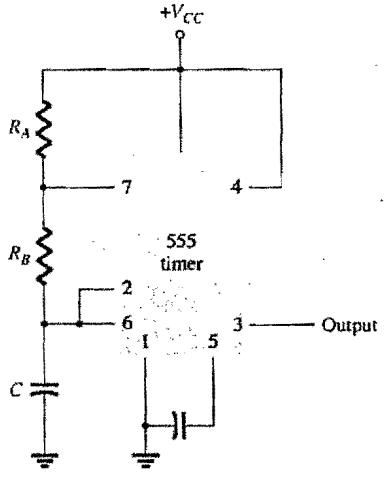


Figure 5b: 555 Astable Timer

[10 marks]

QUESTION 2

Feedbacks are often implemented in amplifier circuits, and are connected in series-shunt, series-series, shunt-shunt, shunt-series connection types. Explain in your own words why it is necessary to have feedbacks in amplifier circuits and relate how the different connections characteristics contribute to the most desirable (almost ideal) characteristics of an amplifier.

[10 marks]

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FAKULTI KEJURUTERAAN
(Faculty of Engineering)

Rangkaian Data dan Komputer
(Data and Computer Networking)

KNL 4193/3333

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	13 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	2.00 pm – 5.00 pm
Tempat *(Place)*	:	DK 1	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Dr. Licha Mued			

Arahan *(Instruction)* :

1. **Jawab semua LIMA (5) soalan.**
   (Answer all five (5) questions.
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

ANSWER ALL *FIVE* QUESTIONS

Question 1 [20 Marks]

(a) What are the four main responsibilities of the data link layer in the OSI model? **[4 marks]**

(b) What is the wavelength of a signal and how is it calculated? **[3 marks]**

(c) What does the Shannon capacity have to do with communications? **[3 marks]**

(d) Draw two periods of a sine wave with a phase shift of 90 degrees. On the same diagram, draw a sine wave with the same amplitude and frequency but with a 90 degrees phase shift from the first. **[5 marks]**

(e) Draw a hybrid topology with a bus backbone connecting two ring backbones. Each ring backbone connects three star networks. **[5 marks]**

Question 2 [20 Marks]

(a) Define the term *multiplexing*. With the help of block diagrams, distinguish the difference between Time-division multiplexing (TDM) and Frequency-division multiplexing (FDM) **[5 marks]**

(b) Five channels, each with a 100-KHz bandwidth, are to be multiplexed together. What is the minimum bandwidth of the link if there is a need for a guard band of 10 KHz between the channels to prevent interference? **[3 marks]**

(c) Four channels are multiplexed using TDM. Each channel creates 250 characters per second. If the interleaved unit is a character and 1 synchronizing bit is added to each frame, find: **[12 marks]**

i. the data rate of each source,
ii. the duration of each character in each source
iii. the frame rate
iv. the duration of each frame
v. the number of bits in one frame
vi. the data rate of the link.

Question 3 [20 Marks]

(a) Explain what is Hamming code and how it is being used in burst errors conditions. **[3 marks]**

(b) List down three protocols used in Wide Area Network (WAN) **[3 marks]**

(c) Describe the following:
- Router **[3 marks]**
- Bridge **[3 marks]**
- Gateway **[3 marks]**

(d) Differentiate between circuit-switched network and packet-switched network **[5 marks]**

Question 4 [20 Marks]

(a) A new company wanted to set up its own LAN using Thick Ethernet. With the help of a diagram, propose how the LAN can be implemented. **[7 marks]**

(b) The ATM standard defines three (3) layers. What are these layers and specify the functions of each. Draw a diagram to show the ATM Layers in End-point Devices and Switches. **[7 marks]**

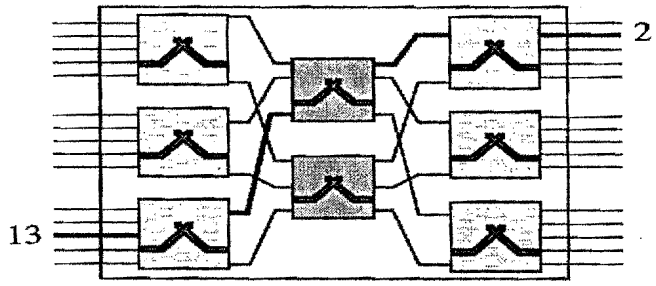
(c) Make comparisons between X.25 and Frame Relay. **[6 marks]**

Question 5 [20 Marks]

(a) Explain how CSMA/CD method used in Ethernet. **[5 marks]**

(b) What are the names of three (3) switching technologies utilized by public switched telephone network (PSTN) for data transmission? ***Briefly***, distinguish between these three switches. **[6 marks]**

(c) Find the total number of crosspoints needed for the multistage switch shown below. **[3 marks]**



13 connected to 2

(d) A large business information system including its supporting communication is always in a state of net expansion and contraction. ***Briefly*** discuss its implication for network designer. **[6 marks]**

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FAKULTI KEJURUTERAAN

(Faculty of Engineering)

TEKNOLOGI DAN REKABENTUK VLSI

(VLSI Technology and Design)

KNL 4213

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	21 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	2:00 – 5:00 pm
Tempat *(Place)*	:	BS 11	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Norhuzaimin Julai			

Arahan *(Instruction)* :

1. **Jawab Semua soalan**
   (Answer all questions)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
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   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

Use the following constants where appropriate

V_T	25 mV at room temperature
ε_{ox}	3.45×10^{-11} F/m
ε_o	8.85×10^{-12} F/m
ε_s	1.04×10^{-10} F/m
q	1.6×10^{-19} C

SECTION A: Answer All Questions

QUESTION 1

An enhancement-type nMOS transistor has the following parameters

$VTO = 0.8$ V
$\gamma = 0.2\ V^{1/2}$
$\lambda = 0.05\ V^{-1}$
$|2\Phi_F| = 0.58$ V
$k' = 20\ \mu A/V^2$

(a) When the transistor is biased with $V_G = 2.8$ V, $V_D = 5$ V, $V_S = 1$ V, and $V_B = 0$ V, the drain current is $I_D = 0.24$ mA. Determine W/L **[9 mark]**

(b) Calculate I_D for $V_G = 5$ V, $V_D = 4$ V, $V_S = 2$ V, and $V_B = 0$V **[8 mark]**

(c) If $\mu_n = 500\ cm^2/V.s$ and $C_g = C_{ox}.W.L = 1.0 \times 10^{-15}$, find W and L **[8 mark]**

QUESTION 2

Design a resistive-load inverter with $R = 1\ k\Omega$, such that $V_{OL} = 0.6$ V. The enhancement-type nMOS driver transistor has the following parameters

$V_{DD} = 5.0$ V
$V_{TO} = 1.0$ V
$\gamma = 0.2\ V^{1/2}$
$\lambda = 0$
$\mu_n C_{ox} = 22.0\ \mu A/V^2$

(a) Determine the required aspect ratio, W/L **[8 mark]**

(b) Determine V_{IL} and V_{IH} **[9 mark]**

(c) Determine the noise margin, NM_L and NM_H **[8 mark]**

QUESTION 3

Consider the n-channel enhancement-type MOSFET shown by figure 1. The process parameters are given as follows

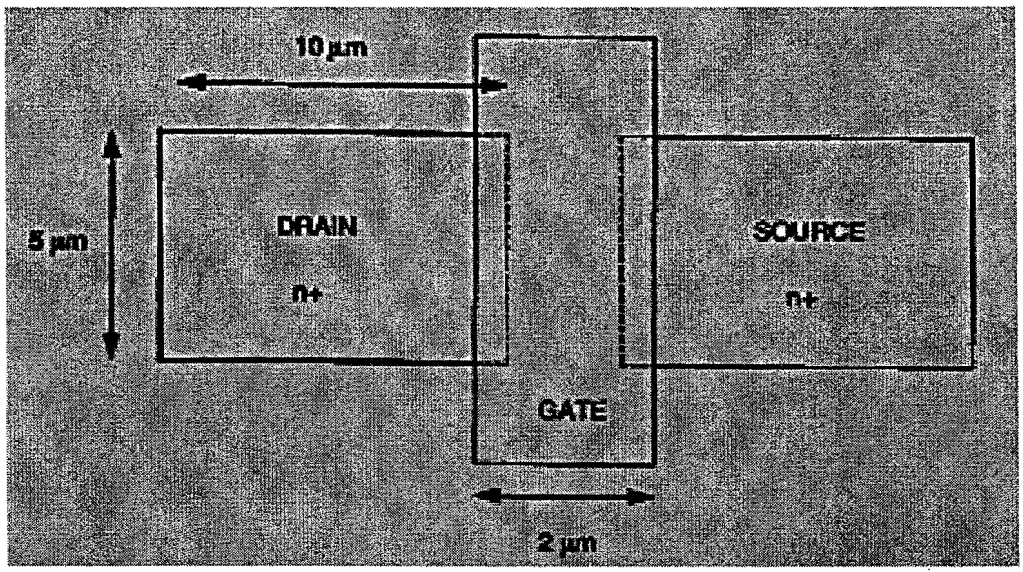


Figure 1

Substrate doping	$N_A = 2 \times 10^{15}$ cm^{-3}
Source/drain doping	$N_D = 10^{19}$ cm^{-3}
Sidewall (p+) doping	$N_{A(sw)} = 4 \times 10^{16}$ cm^{-3}
Gate oxide thickness	$t_{ox} = 45$ nm
Junction depth	$x_j = 1.0$ µm

Find the following values

(a) Build-in-junction potential, Φ_0 **[5 mark]**

(b) Build-in potential of the sidewall junction, Φ_{0sw} **[5 mark]**

(c) Zero-bias junction capacitance per unit area, C_{j0} **[7 mark]**

(d) Zero-bias sidewall junction capacitance per unit area, C_{j0sw} **[8 mark]**

QUESTION 4

Figure 2 shows a complex CMOS logic gates

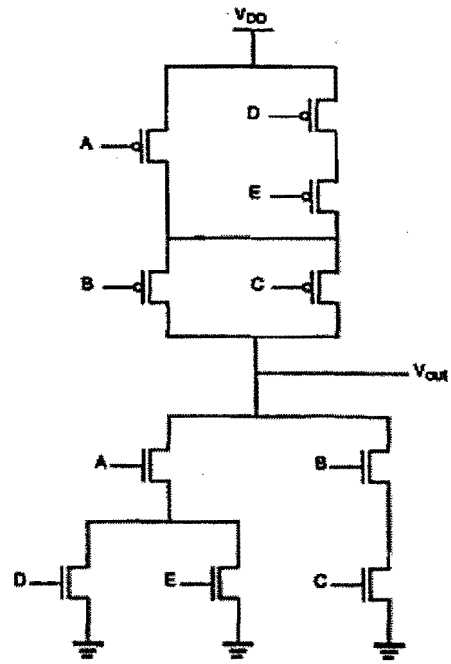


Figure 2

(a) Derive the Boolean function at the output logic gates, V_{out} **[3 mark]**

(b) A simple method for finding the optimum gate ordering is the Euler path approach. Draw the Euler path of the CMOS logic gate. **[6 mark]**

(c) Based on drawing in part (b), what is the common Euler path? **[3 mark]**

(d) Hence, draw the stick diagram of the complex CMOS logic gates. **[13 mark]**

QUESTION 5

(a) The simplified layout of a CMOS complex logic circuit is given by figure 3

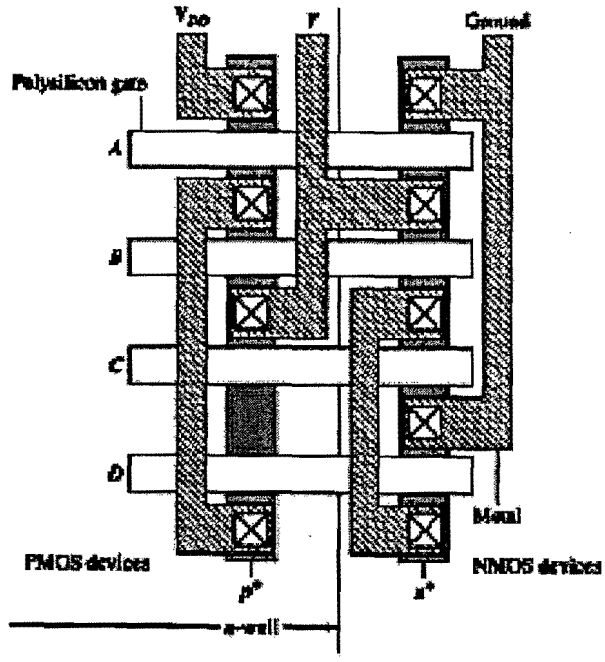


Figure 3

(i) Draw the corresponding circuit diagram **[6 mark]**

(ii) Draw the corresponding Euler Path **[4 mark]**

(iii) Find the Output Boolean function . **[3 mark]**

(b) Draw a CMOS transistor-level schematic for the following logic function

(i) $X = \overline{(A.B + C)}$ **[6 mark]**

(ii) $Y = \overline{(A.B + C.D)}$ **[6 mark]**

QUESTION 6

Use the data and assumption in "Lampiran A" to answer the following questions.

(a) Figure 1 shows the CMOS gate with the gate length is 2λ. Calculate the total input and output capacitances (do not neglect the source/drain diffusion area/parameter terms but you can neglect gate-source overlap term). Calculate the effective resistance for the NMOS and PMOS devices **[10 mark]**

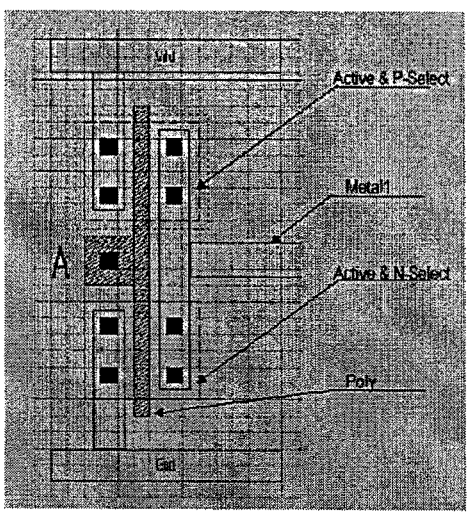


Figure 1

(b) Calculate the output-rising and output-falling gate delays for circuit in (a) driving an identical circuit. (See figure 1) **[5 mark]**

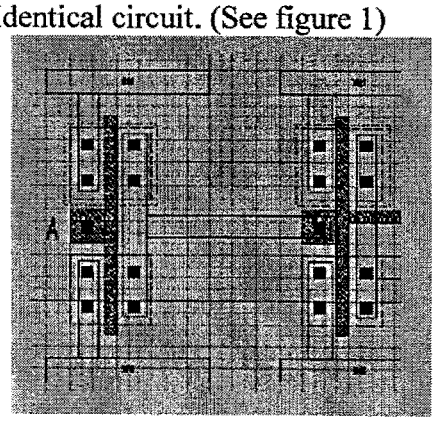


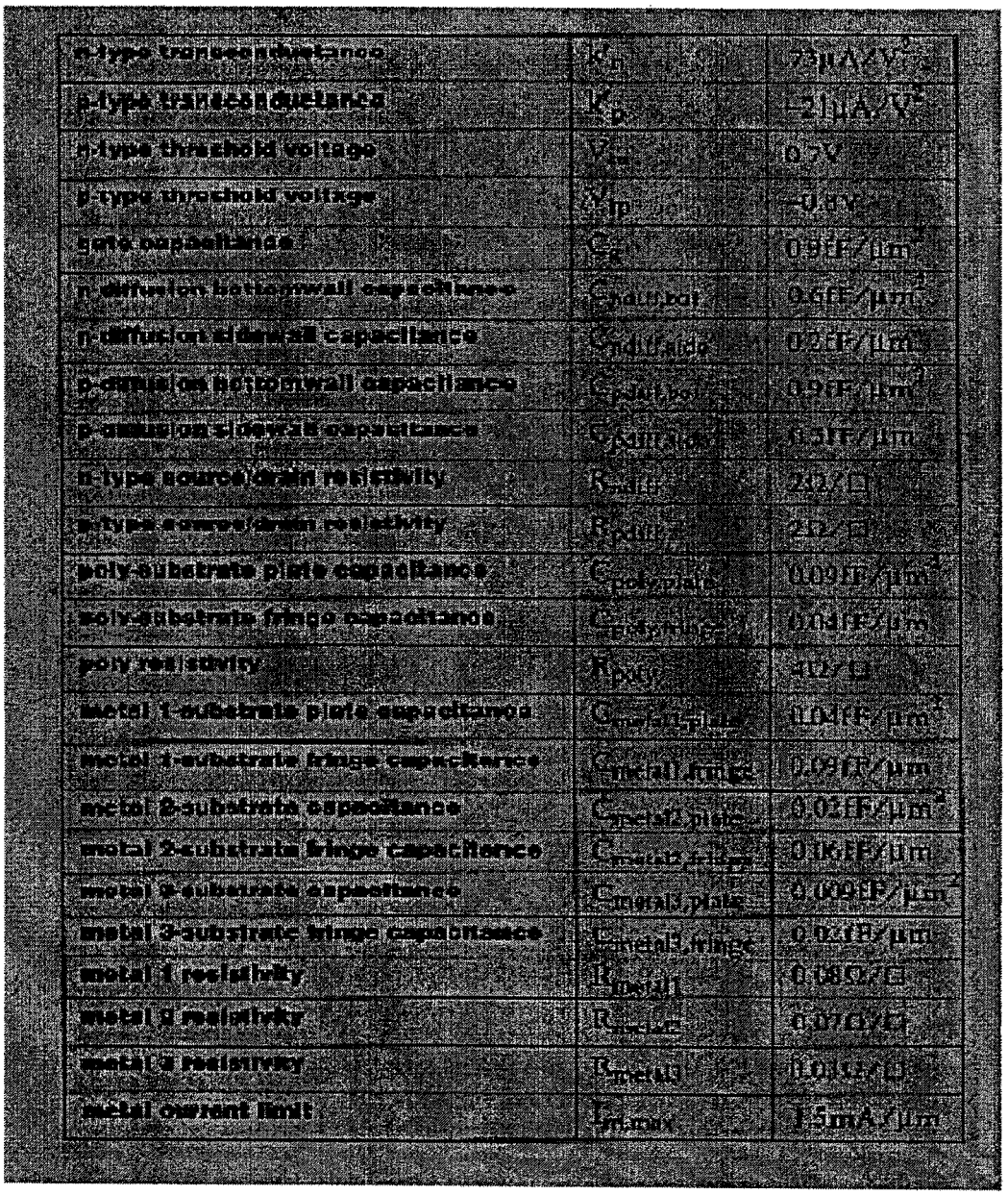
Figure 1

(c) The gate in problem (a) drives 0.1 pF capacitor load. Calculate the output rising and output falling gate delay for this case. **[5 mark]**

(d) How would you improve the gate performance?Estimate the new rise and fall time delays for your proposed circuit **[5 mark]**

LAMPIRAN A

Power supply	V_{DD}	=	5 V
Lambda	λ	=	0.25 micron
Mos Effective resistance	R	=	$0.5\ [(V_{sat}/I_{sat}) + (V_{lin}/I_{lin})]$
	I_{sat}	=	$0.5k'(W/L)(V_{DD} - V_T)^2$
	I_{lin}	=	$(3/8)k'(W/L)(V_{DD} - V_T)^2$
	V_{sat}	=	V_{DD}
	V_{lin}	=	$(V_{DD}-V_T)/2$
Gate Delay (10%-90%)	T	=	$2.2\ R_{TOT}.C_{TOT}$



n-type transconductance	k'_n	73μA/V^2
p-type transconductance	k'_p	21μA/V^2
n-type threshold voltage	V_{tn}	0.7V
p-type threshold voltage	V_{tp}	-0.8V
gate capacitance	C_g	0.9fF/μm^2
n-diffusion bottomwall capacitance	$C_{ndiffbot}$	0.56fF/μm^2
n-diffusion sidewall capacitance	$C_{ndiffside}$	0.28F/μm
p-diffusion bottomwall capacitance	$C_{pdiffbot}$	0.9fF/μm^2
p-diffusion sidewall capacitance	$C_{pdiffside}$	0.31F/μm
n-type source/drain resistivity	R_{ndiff}	2kΩ/□
p-type source/drain resistivity	R_{pdiff}	2kΩ/□
poly-substrate plate capacitance	$C_{polyplate}$	0.09fF/μm^2
poly-substrate fringe capacitance	$C_{polyfringe}$	0.04fF/μm
poly resistivity	R_{poly}	8Ω/□
metal 1-substrate plate capacitance	$C_{metal1plate}$	0.04fF/μm^2
metal 1-substrate fringe capacitance	$C_{metal1fringe}$	0.09fF/μm
metal 2-substrate capacitance	$C_{metal2plate}$	0.02fF/μm^2
metal 2-substrate fringe capacitance	$C_{metal2fringe}$	0.1fF/μm
metal 3-substrate capacitance	$C_{metal3plate}$	0.009fF/μm^2
metal 3-substrate fringe capacitance	$C_{metal3fringe}$	0.04fF/μm
metal 1 resistivity	R_{metal1}	0.08Ω/□
metal 2 resistivity	R_{metal2}	0.07Ω/□
metal 3 resistivity	R_{metal3}	0.03Ω/□
metal current limit	$I_{metalmax}$	1.5mA/μm

UNIVERSITI MALAYSIA SARAWAK

94300 KOTA SAMARAHAN
SARAWAK

FAKULTI KEJURUTERAAN

(Faculty of Engineering)

Pemprosesan Isyarat Digital

(Digital Signal Processing)

KNL 3313/3172

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	20 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	9.00 am – 12.00 pm
Tempat *(Place)*	:	DK 1	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Ng Liang Yew			

Arahan *(Instruction)* :

1. **Jawab semua soalan.**
   (Answer all questions)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

Question 1

a. When the input to a linear, causal, time-invariant system is

$$x[n] = u[n] + (-1/2)^n u[n]$$

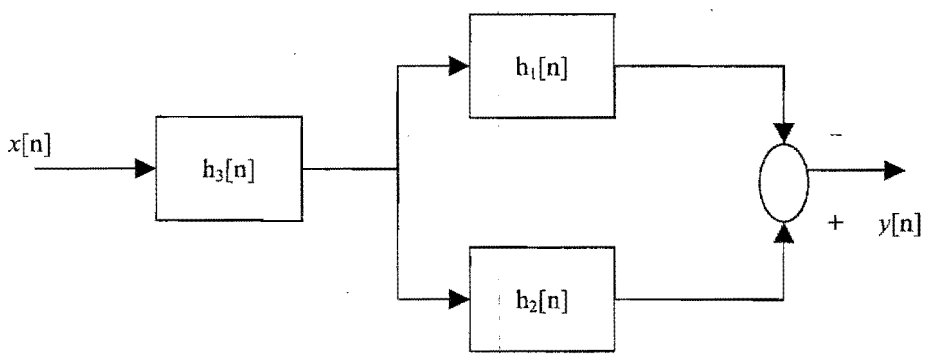
The output is

$$y[n] = 6(-1/4)^n u[n] - 6(-1/3)^n u[n]$$

i. Find the transfer function of the system. **[3 marks]**

ii. What will be the difference equation representation of the system? **[3 marks]**

b. Find the transfer function of the following system.



Given $h_1[n] = (n-1)\,u[n]$

$h_2[n] = \delta[n] + n\,u[n-1] + \delta[n-2]$

$h_3[n] = (1/2)^n u[n]$

[4 marks]

Question 2

Consider the system defined by the difference equation

$$y[n] = x[n] - x[n-1] - y[n-1]$$

i. Find the unit pulse (or impulse) response for the system.

[2 marks]

ii. Find simple expression for the magnitude and phase of the frequency response of this system.

[4 marks]

iii. Sketch the magnitude and phase of the frequency response.

[4 marks]

Question 3

Obtain a realization of the following transfer function as a combination of first and second-order in

i. Cascade.

ii. Parallel.

$$H(z) = \frac{(1 + 0.5z^{-1} + 0.06z^{-2})(1 + 1.7z^{-1} + 0.72z^{-2})}{(1 + 0.4z^{-1} + 0.8z^{-2})(1 - 0.25z^{-1} - 0.125z^{-2})}$$

[10 marks]

Question 4

a. Let $x[n]$ be an N-point sequence with DFT X(k). Find the DFT of the sequence in term of X(k).

$$y[n] = \begin{cases} x[n] & 0 \le n \le N-1 \\ 0 & N \le n \le 2N-1 \end{cases}$$

[3 marks]

b. Use the DFT to find the periodic convolution of the following sequences.

$$x[n] = \{ 1 , -2 , -1 , 1 \}$$

$$h[n] = \{ 1 , 0 , 0 , 1 \}$$

[7 marks]

Question 5

Design a digital Butterworth filter that satisfies the following constraint using bilinear transformation. Assume T = 1s.

$$0.9 \le | H(e^{j\omega}) | \le 1 \qquad 0 \le |\omega| \le (1/2)\pi$$

$$| H(e^{j\omega}) | \le 0.2 \qquad (3/4)\pi \le |\omega| \le \pi$$

[10 marks]

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FAKULTI KEJURUTERAAN
(Faculty of Engineering)

Teori Litar
(Circuit Theory)

KNL 1023

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	18 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	9.00 am – 12.00 pm
Tempat *(Place)*	:	Bilik Seminar 11	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Pn. Siti Kudnie Sahari			

Arahan *(Instruction)* :

1. **Jawab semua soalan di Bahagian A dan DUA (2) soalan di Bahagian B.**
   (Answer all questions in Section A and TWO (2) questions in Section B)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

SECTION A: Answer ALL questions

Question 1

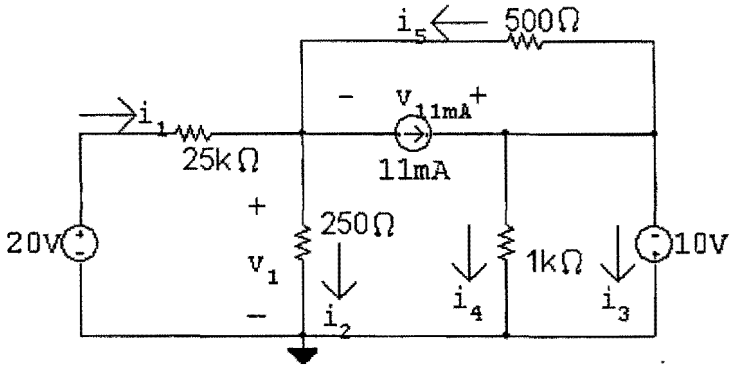

Figure 1

a. Use the node-voltage method to find the branch current i_1, i_2 and i_3 . **[15 marks]**

b. Test your solution for the branch currents by showing that the total power dissipated equals the total power delivered. **[5 marks]**

Question 2

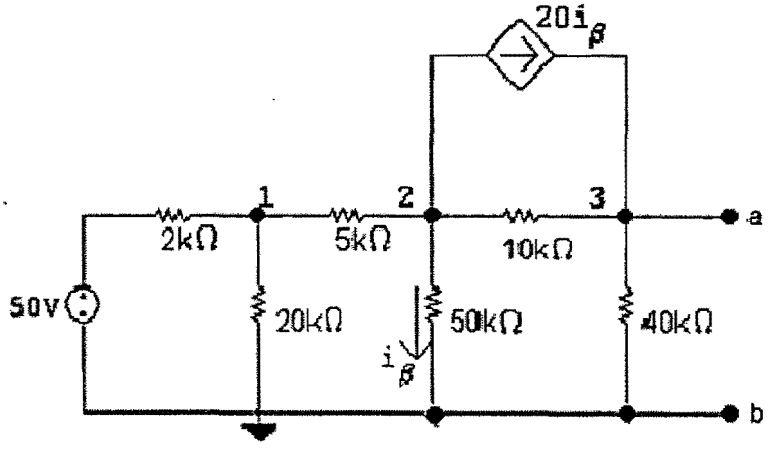

Figure 2

a. Find the Thevenin equivalent with respect to the terminals a, b for the circuit in Figure 2 . **[14 marks]**

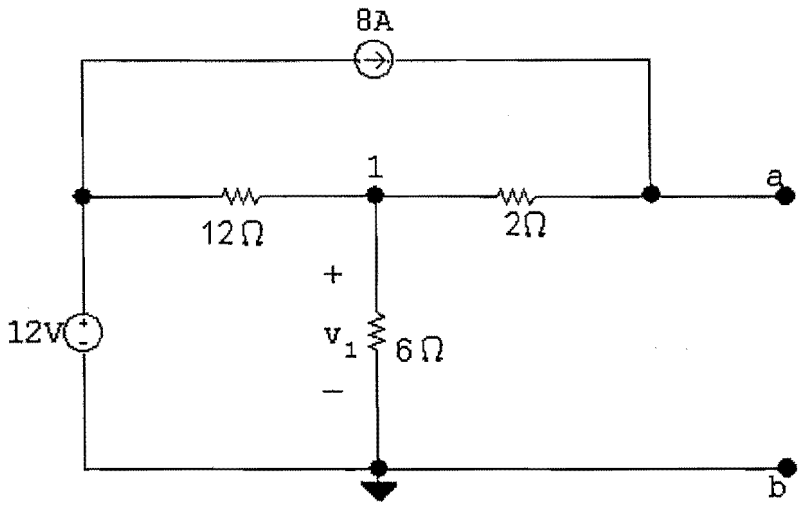

Figure 3

b. Find the Thevenin equivalent with respect to the terminals a, b for the circuit in Figure 3. **[6 marks]**

Question 3

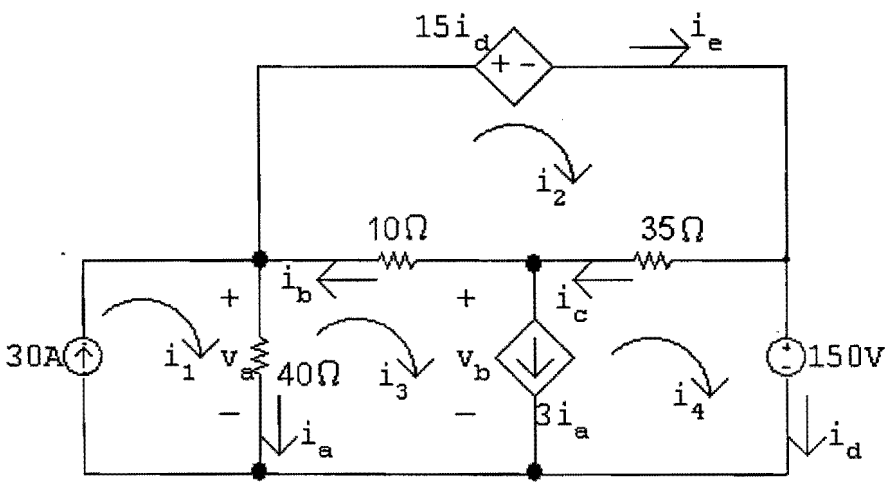

Figure 4

a. Find the branch currents i_a to i_e for the circuit shown in Figure 4. **[14 marks]**

b. Check your answer by showing that the total power generated equals the total power dissipated. **[6 marks]**

SECTION B: Answer ONLY TWO questions

Question 1

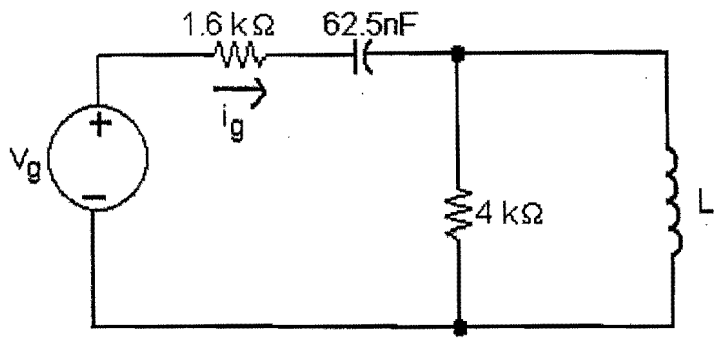

Figure 5

a. The source voltage in the circuit in Figure 5 is $V_g = 96\cos(10000t)\ V$. Find the values of L such that i_g is in phase with V_g when the circuit operating in the steady state. **[10 marks]**

b. For the values of L found in (a), find the steady-state expression for i_g. **[10 marks]**

Question 2

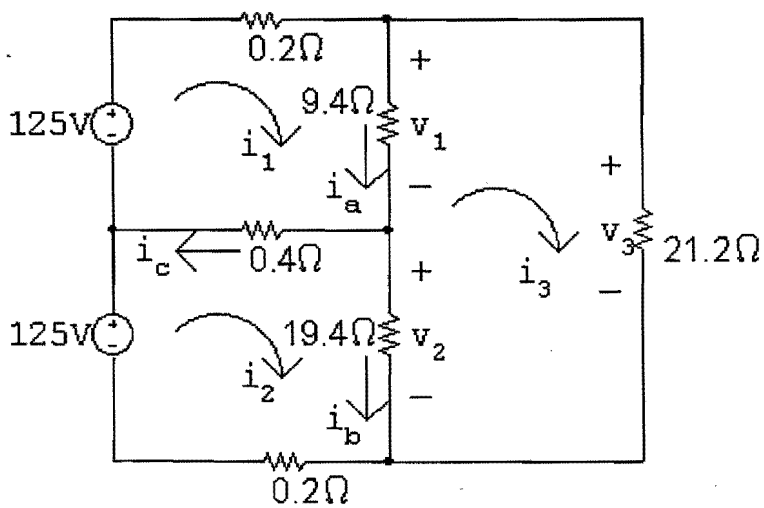

Figure 6

The Circuit in Figure 6 is a direct-current division of a typical three-

wire distribution system. The resistor R_a = 0.2Ω, R_b = 0.4 Ω and R_c =0.2 Ω represent the resistances of the three conductors that connect the three loads R_1 = 9.4Ω, R_2 = 19.4Ω *and* R_3 = 21.2Ω to the 125/250 voltage supply. The resistor R_1 and R_2 represent loads connected to the 125 V circuits and R_3 represents a load connected to the 250 V circuit.

a. Calculate V_1, V_2 and V_3 **[7 marks]**

b. Calculate the power delivered to R_1, R_2, R_3 . **[6 marks]**

c. The R_b branch represents the neutral conductor in the distribution circuit. What adverse effect occurs if the neutral conductor is opened? (*Hint: Calculate V_1, and V_2 and note that appliances or loads designed for use in this circuit would have nominal voltage rating of 125V)*. **[7 marks]**

Question 3

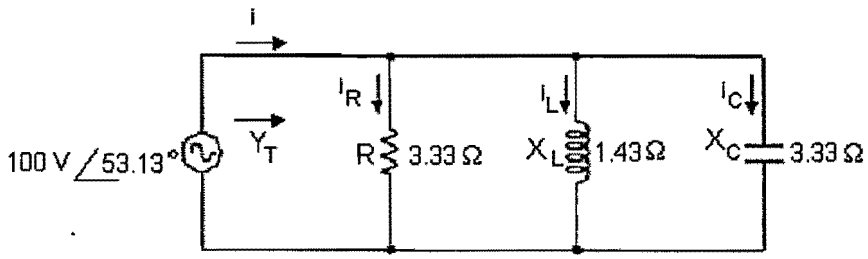

Figure 7

For the parallel *R-L-C* circuit of Figure 7

a. Total a.c admittance and impedance of the circuit and draw the admittance diagram. **[5 marks]**

b. Total current and current through the resistor and inductor elements and draw the phasor diagram. **[5 marks]**

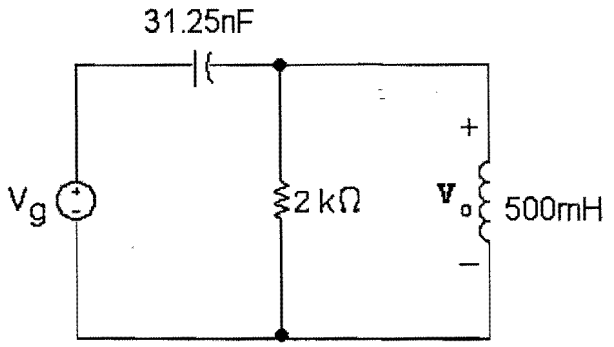

Figure 8

c. The circuit in Figure 8 is operating in the sinusoidal steady state. Find the steady state expression for $V_0(t)$ if $V_g = 64\cos 8000t\ V$. **[10 marks]**

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FAKULTI KEJURUTERAAN
(Faculty of Engineering)

PRINSIP KEJURUTERAAN TELEKOMUNIKASI
(Telecommunication Engineering Principle)

KNL 2283

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	15 October 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	9.00 a.m – 12.00 p.m
Tempat *(Place)*	:	Bilik Seminar 12	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Pn. Siti Kudnie Sahari			

Arahan *(Instruction)* :

1. **Jawab Semua soalan di Bahagian A dan DUA soalan di Bahagian B.**
   (Answer all questions in Section A and TWO questions in Section B)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

SECTION A: Answer ALL questions

Question 1

a. Define electrical noise and explain why it is so troublesome to a communications receiver. **[5 marks]**

b. Define modulation. Describe the two reasons that modulation is used for communication transmission. **[5 marks]**

c. List the 2 basic limitations on the performance of communications system. **[5 marks]**

d Define noise factor and noise figure and describe their significance. **[5 marks]**

Question 2

a. A three-stage amplifier system has effective noise bandwidth $3.14\times10^5 Hz$ determine by LC tuned circuit at its input and operates at $25\,°C$. The first stage has a power gain of 14dB and NF of 3dB. The second and third stages are identical, with power gain 14dB and NF = 8dB. The output load is $300\,\Omega$. The input noise is generated by a 15k Ω resistor. Assume ideal noiseless amplifiers. Calculate

(i) Noise voltage and power at input **[4 marks]**

(ii) Noise voltage and power at output of this system **[6 marks]**

b. A three –stage system comprised of two amplifiers and one filter. The input power P_{in}=0.1mW. The absolute power gains are A_{P_1}=100, A_{P_2}=40 and A_{P_3} = 0.25. Determine:

(i) The input power in dBm **[2 marks]**

(ii) Output power (P_{out}) in watts and dBm **[2 marks]**

(iii) The dB gain of each of the three stages **[3 marks]**

(iv) The overall gain in dB **[3 marks]**

Question 3

a. Compare analog and digital representation in terms of potential for error-free transmission, required bandwidth, and efficient use of bandwidth. **[6 marks]**

b. Give the potential benefits of preprocessing and postprocessing in video signal transmission. **[4 marks]**

c. How does a digital system regenerate a signal after noise has corrupted it, with the no degradation in SNR? **[5 marks]**

d. What is noise margin? How does it determine how much noise can be tolerated before the digital signal is incorrectly received? **[5 marks]**

SECTION B: Answer ONLY TWO questions

Question 1

a. Contrast natural and flat-top sampling. **[4 marks]**

b. What are the four most common methods of pulse modulation. **[4 marks]**

c. Draw and explain the block diagram of the PCM process. **[6 marks]**

d. Define Delta Modulation. Compare to the Pulse Code Modulation. **[6 marks]**

Question 2

Explain briefly on:

a. North American Digital Hierarchy **[5 marks]**

b. SONET **[5 marks]**

c. Asynchronous Transfer Mode **[5 marks]**

d. High Definition Television **[5 marks]**

Question 3

Explain briefly and write the general expression on:

a. Amplitude Shift Keying **[7 marks]**

b. Frequency Shift Keying **[7 marks]**

c. Phase Shift Keying **[6 marks]**

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FAKULTI KEJURUTERAAN

(Faculty of Engineering)

MIKROELEKTRONIK

(Microelectronic)

KNL 3183

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	18 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	2:00 – 5:00 pm
Tempat *(Place)*	:	DK 1	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Norhuzaimin Julai			

Arahan *(Instruction)* :

1. **Jawab Semua soalan**
   (Answer all questions)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
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5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

Use the following constants where appropriate

V_T	25 mV at room temperature
ε_{ox}	3.45×10^{-11} F/m
ε_o	8.85×10^{-12} F/m
ε_s	1.04×10^{-10} F/m
q	1.6×10^{-19} C

SECTION A: Answer All Questions

QUESTION 1

(a) Explain the operation of pn junction (in terms of majority/minority carriers, diffusion current and depletion region etc) under the following conditions. (Note: Appropriate diagrams should be included).

(i) Open-circuit condition. **[3 mark]**

(ii) Reverse-bias condition. **[3 mark]**

(iii) Forward-bias condition. **[3 mark]**

(b) A diode has $N_A = 10^{17}/cm^3$, $N_D = 10^{16}/cm^3$, $n_i = 1.5 \times 10^{10}/cm^3$, Lp = 5 μm, Ln = 10 μm, A = 2500 μm2, D_p (in the n region) = 10 $cm^2/V.s$, and D_n (in the p region) = 18 $cm^2/V.s$. The diode is forward biased and conducting a current I = 0.1 mA. Calculate

(i) I_s **[2 mark]**

(ii) The forward-bias voltage. **[2 mark]**

(iii) The component of the current I due to the hole injection and that due to electron injection across the junction. **[3 mark]**

(iv) τ_p and τ_n. **[4 mark]**

(v) The excess hole charge in the n region Q_p and the excess hole charge in the p region Q_n. **[3 mark]**

(vi) The diffusion capacitance. **[2 mark]**

QUESTION 2

The PMOS transistor in the circuit as shown in Figure 1, has the following parameters, $k_p' = 8\ \mu A/V^2$, $W/L = 25$ and $|V_{tp}| = 1V$. Given that the value of $I = 100\ \mu A$.

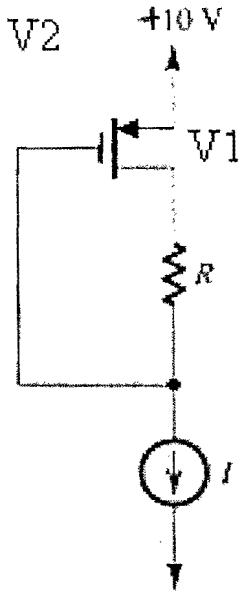

Figure 1

(a) For part (i), (ii) and (iii), find the voltages V_{SD} (V1) and V_{SG} (V2) for R under the following cases.

(i) $R = 10\ K\Omega$ **[4 mark]**

(ii) $R = 30\ K\Omega$ **[4 mark]**

(iii) $R = 100\ K\Omega$ **[4 mark]**

(b) Find the value of R under the following cases.

(iv) $V_{SD} = V_{SG}$ **[4 mark]**

(v) $V_{SD} = V_{SG}/2$ **[4 mark]**

(vi) $V_{SD} = V_{SG}/10$ **[5 mark]**

QUESTION 3

Consider a CMOS process for which $L_{min} = 0.8\ \mu m$, $t_{ox} = 15$ nm, $\mu_n = 550\ cm^2/V.s$ and $V_t = 0.7$ V.

(a) Find C_{ox} and k_n'. **[8 mark]**

(b) For an NMOS transistor with W/L = 16 μm/0.8 μm, calculate the values of V_{OV}, V_{GS} and V_{DSMIN} needed to operate the transistor in saturation region with a dc current $I_D = 100\ \mu A$. **[8 mark]**

(c) For the device in (b), find the value of V_{OV} and V_{GS} required to cause the device operate as a 1000 Ω resistor for very small V_{DS}. **[9 mark]**

QUESTION 4

(a) Explain the operation of digital logic inverter (in terms of static characteristics and dynamic operation).(Note : Appropriate diagrams should be included). **[7 mark]**

(b) For a digital logic inverter fabricated in a 0.8-μm CMOS technology for which $k_n' = 120\ \mu A/V^2$, $k_p' = 60\ \mu A/V^2$, $V_{tn} = |V_{tp}| = 0.7$ V, $V_{DD} = 3$V, $L_n = L_p = 0.8\ \mu m$, $W_n = 1.2\ \mu m$ and $W_p = 2.4\ \mu m$, find

(i) The output resistance for $v_0 = V_{OL}$ and for $v_0 = V_{OH}$. **[5 mark]**

(ii) The maximum current that the inverter can sink or source while the output remains within 0.1 V of ground or V_{DD} respectively. **[5 mark]**

(iii) V_{IH}, V_{IL}, NM_H and NM_L. **[8 mark]**

QUESTION 5

(a) There are two types of MOS RAM: Static and dynamic. Explain the operation of both MOS RAM.(Note : Appropriate diagrams should be included). **[9 mark]**

(b) Figure 2 shows the condition immediately following activation of the wordline during read operation. Find bitline currents i_1 and i_2 in figure 1 immediately following activation of the wordline. Assume W/L = 2/1 for all devices and use V_{DD} = 5 V, WL = 5 V, the bitline voltages are 2.5 V, $k_n' = 25\ \mu A/V^2$, $V_{TO} = 1$ V, $\gamma = 0.6\ V^{1/2}$, and $2\Phi_F = 0.6$ V. **[8 mark]**

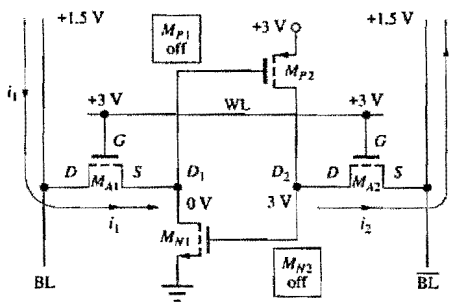

Figure 2

(c) Figure 3 shows the condition immediately following activation of the wordline during write operation. Find bitline currents i_1 and i_2 in figure 1 immediately following activation of the wordline. Assume W/L = 2/1 for all devices and use V_{DD} = 5 V, WL = 5 V, the bitline voltages are 2.5 V, $k_n' = 25\ \mu A/V^2$, $V_{TO} = 1$ V, $\gamma = 0.6\ V^{1/2}$, and $2\Phi_F = 0.6$ V. **[8 mark]**

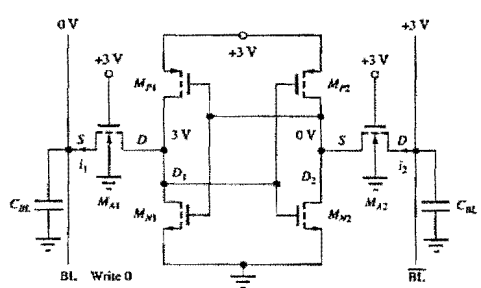

Figure 3

QUESTION 6

Figure 4 shows a discrete-circuit CS amplifier employing the classical biasing scheme. The input signal, v_{sig} is coupled to the gate through a very large capacitor (shown as infinite). The transistor source is connected to the ground at signal frequencies via a very large capacitor (shown as infinite). The output voltage signal that develops at the drain is coupled to a load resistance via a very large capacitor (shown as infinite).

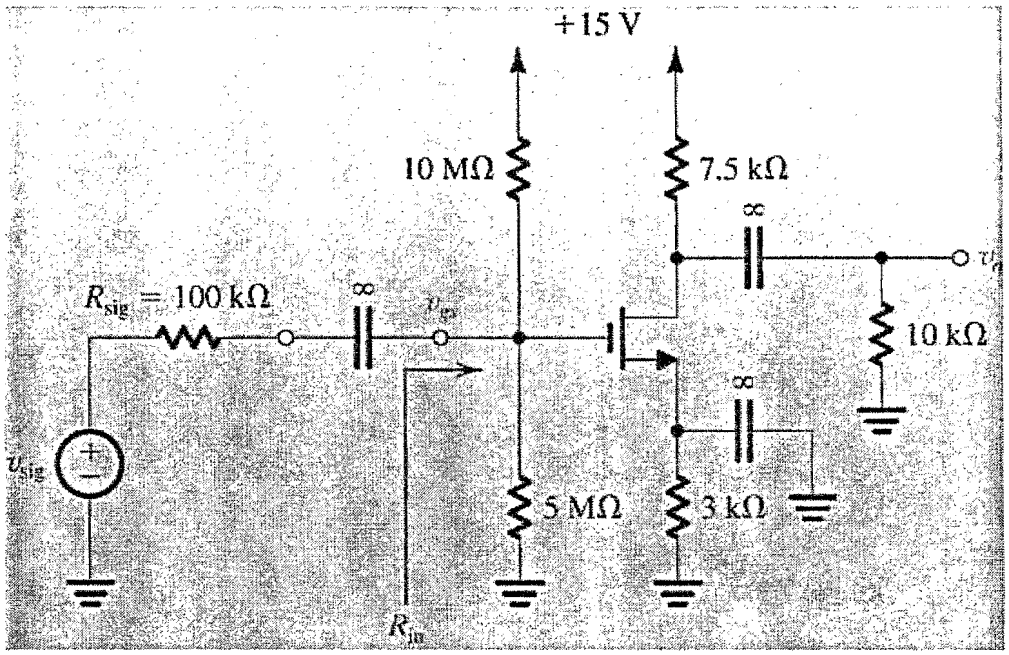

Figure 4

(a) If the transistor has $V_t = 1$ V, and $k_n'W/L = 2mA/V^2$, verify that the bias circuit establishes $V_{GS} = 2$ V, $I_D = 1$ mA, and $V_D = +7.5$ V. That is assume these values, and verify that they are consistent with the values of the circuit components and device parameters. **[7 mark]**

(b) Find g_m and r_0 if $V_A = 100$ V. **[6 mark]**

(c) Draw a complete small signal equivalent circuit for the amplifier assuming all capacitors behave as short circuits at signal frequencies. **[6 mark]**

(d) Find R_{in}, v_{gs}/v_{sig}, v_0/v_{gs} and v_0/v_{sig}. **[6 mark]**

FAKULTI KEJURUTERAAN

SET-SET SOALAN
KURSUS FAKULTI

25 OKTOBER 2004

UNIVERSITI MALAYSIA SARAWAK

94300 KOTA SAMARAHAN
SARAWAK

FAKULTI KEJURUTERAAN

(Faculty of Engineering)

Pemprograman Kejuruteraan

(Engineering Programming)

KNF 1082

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	12 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	2.00 pm – 5.00 pm
Tempat *(Place)*	:	Dewan Kuliah I	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Dr. Vishwas A. Sawant			

Arahan *(Instruction)* :

1. **Terdapat ENAM (6) soalan dalam kertas ujian ini. Pelajar boleh menjawab kesemuanya atau sekurang-kurangnya (LIMA) 5 soalan. Hanya markah terbaik dari LIMA (5) soalan sahaja akan diambil kira.**
   (There are SIX (6) questions. Answer any FIVE (5) questions. If student attempts all SIX (6) questions, then best FIVE (5) will be counted for marks)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

Solve ANY FIVE (5) questions. Each question carries 20 Marks.

1. Real variables a, b, and c contain the values –10., 0.1 and 2.1, respectively, and the logical variable L1, L2 and L3 contains the values .TRUE., . FALSE. and .FALSE., respectively. Is each of the following expression is legal or illegal? If an expression is legal, what is the result? ***(Each 2 Marks)*** **[20 marks]**

   a) a > b .OR. b > c
   b) (.NOT. a) .OR. L1
   c) L1 .AND. .NOT. L2
   d) a < b .EQV. b < c
   e) L1 .OR. L2 .AND. L3
   f) L1 .OR. (L2 .AND. L3)
   g) (L1 .OR. L2) .AND. L3
   h) a .OR. b .AND. L1
   i) .NOT. (L1 .EQV. L2)
   j) L2 .NEQV. L3

2. Examine the following Fortran statements. Are they correct or incorrect? If they are correct, what is output by them? If they are incorrect, what is wrong with them? ***(Each 5 Marks)*** **[20 marks]**

   a)
```
PROGRAM test1
REAL, DIMENSION(120) :: a
REAL :: average, sd
INTEGER :: n
....
CALL ave_sd(a,120, n, average, sd)
...
END PROGRAM test1
SUBROUTINE ave_sd(array, nval, n, average, sd)
REAL, INTENT(IN) :: nval, n
REAL, INTENT(IN), DIMENSION(nval) :: array
REAL, INTENT(IN) :: average, sd
....
END SUBROUTINE ave_sd
```

   b)
```
MODULE mydata
IMPLICIT NONE
REAL, SAVE, DIMENSION(8) :: a
REAL, SAVE :: b
END MODULE mydata

PROGRAM test1
USE mydata
IMPLICIT NONE
a = (/1., 2., 3., 4., 5., 6., 7., 8./)
b = 37.
CALL sub1
END PROGRAM test1
SUBROUTINE sub1
USE mydata
```

```
IMPLICIT NONE
WRITE(*,*) 'a(5) = ', a(5)
END SUBROUTINE sub1
```

c)
```
CHARACTER (len=6) :: color = 'yellow'
SELECT CASE ( color )
   CASE ( 'red' )
      WRITE (*,*) 'Stop now! '
   CASE ( 'yellow' )
      WRITE (*,*) 'Prepare to stop. '
   CASE ( 'green' )
      WRITE (*,*) 'Proceed through intersection. '
   CASE DEFAULT
      WRITE (*,*) 'Illegal color encountered.'
END SELECT
```

d)
```
PROGRAM quiz
   INTEGER :: i, j, k
   LOGICAL :: L
   READ (*,*) i, j
   READ (*,*) k
   L = i + j == k
   WRITE (*,*) L
   END PROGRAM quiz
```

The input data are :
1, 3, 5
2, 4, 6

3. a) Write a function **DET(A)** to calculate the determinant of 3 × 3 matrix. **[5 marks]**

$$\begin{vmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{vmatrix} = a_{11}(a_{22}a_{33} - a_{23}a_{32}) - a_{12}(a_{21}a_{33} - a_{23}a_{31}) + a_{13}(a_{21}a_{32} - a_{22}a_{31})$$

[15 marks]

b) Write a program to solve set of three simultaneous equations by Cramer's rule.

$$a_{11}x_1 + a_{12}x_2 + a_{13}x_3 = b_1$$
$$a_{21}x_1 + a_{22}x_2 + a_{23}x_3 = b_2$$

where a_{ij} and b_i are constants, and x_i are the unknowns.
Then by Cramer's Rule

$$x_1 = \frac{\begin{vmatrix} b_1 & a_{12} & a_{13} \\ b_2 & a_{22} & a_{23} \\ b_3 & a_{32} & a_{33} \end{vmatrix}}{\begin{vmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{vmatrix}} \quad x_2 = \frac{\begin{vmatrix} a_{11} & b_1 & a_{13} \\ a_{21} & b_2 & a_{23} \\ a_{31} & b_3 & a_{33} \end{vmatrix}}{\begin{vmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{vmatrix}} \quad x_3 = \frac{\begin{vmatrix} a_{11} & a_{12} & b_1 \\ a_{21} & a_{22} & b_2 \\ a_{31} & a_{32} & b_3 \end{vmatrix}}{\begin{vmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{vmatrix}}$$

Write a main program that reads the coefficient of matrix A and constant vector B. Then write subroutine CRAMER which is called from main program to solve for unknowns. Use the Function DET developed for part (a).

4. Write a subroutine MATMUL to multiply matrix A (M×L) and Matrix B (L×N) to get matrix C(M×N). Write a main Program to Read Matrix A, and B, then call subroutine MATMUL to multiply them. Print resultant matrix C. **[20 marks]**

5. Examine the following Fortran program. Are they correct or incorrect? If they are correct, what is output by them? **[20 marks]**

```
MODULE vector_module
IMPLICIT NONE
TYPE :: vector
 REAL :: x
 REAL :: y
 REAL :: z
END TYPE vector

CONTAINS
 TYPE (vector) FUNCTION vector_add ( v1, v2 )
 IMPLICIT NONE
 TYPE (vector), INTENT(IN) :: v1, v2
 vector_add%x = v1%x + v2%x
 vector_add%y = v1%y + v2%y
 vector_add%z = v1%z + v2%z
 END FUNCTION vector_add

 TYPE (vector) FUNCTION vector_sub ( v1, v2 )
 IMPLICIT NONE
 TYPE (vector), INTENT(IN) :: v1, v2
 vector_sub%x = v1%x - v2%x
 vector_sub%y = v1%y - v2%y
 vector_sub%z = v1%z - v2%z
 END FUNCTION vector_sub

 REAL FUNCTION vector_dot ( v1, v2 )
 IMPLICIT NONE
 TYPE (vector), INTENT(IN) :: v1, v2
 vector_dot = v1%x * v2%x + v1%y * v2%y +  v1%z * v2%z
 END FUNCTION vector_dot

 TYPE (vector) FUNCTION vector_crp ( v1, v2 )
 IMPLICIT NONE
 TYPE (vector), INTENT(IN) :: v1, v2
 vector_crp%x = v1%y * v2%z - v2%y * v1%z
 vector_crp%y = v2%x * v1%z - v1%x * v2%z
 vector_crp%z = v1%x * v2%y - v2%x * v1%y
 END FUNCTION vector_crp
END MODULE vector_module
```

```
PROGRAM test_vector
USE  vector_module
IMPLICIT NONE
TYPE (vector) :: v1, v2

WRITE(*,*) 'Enter the first vector (x,y,z) '
READ(*,*) v1
WRITE(*,*) 'Enter the second vector (x,y,z) '
READ(*,*) v2
WRITE(*,110)vector_add ( v1, v2 )
110 FORMAT(1x,'The sum of vector is (',3(1x,F8.2),' )')
WRITE(*,120)vector_sub ( v1, v2 )
120 FORMAT(1x,'The subtraction of vector is (',3(1x,F8.2),' )')
WRITE(*,130)vector_crp ( v1, v2 )
130 FORMAT(1x,'The cross product of vector is (',3(1x,F8.2),' )')
WRITE(*,140)vector_dot ( v1, v2 )
140 FORMAT(1x,'The dot product of vector is (',1x,F8.2,' )')

END PROGRAM test_vector
```

The input data are :
5.0, 4.0, 3.0
2.0, 3.0, 4.0

6a) Examine the following DO loops and determine how many times each loop is executed. Assume all the index variables shown are integer. **[6 marks]**

1) DO index = 7, 10
2) DO j = 7, 10, -1
3) DO index = 1, 10, 10
4) DO loop_counter = -2, 10, 2
5) DO time = -2, -10, -1
6) DO i = -10, -7, -3

6b) Examine the following Fortran statements and tell whether or not they are valid. If they are invalid, indicate the reason why they are invalid. **[4 marks]**

1)
```
Loop1 : DO i = 1, 10
        Loop2 : DO j = 1, 10
                Loop3 : DO i = i, j
                .......
                END DO Loop3
        END DO Loop2
END DO Loop1
```

2)
```
Loop1 : DO i = 1, 10
        Loop2 : DO j = 1, 10
                Loop3 : DO i = i, j
                .......
                END DO Loop3
        END DO Loop2
END DO Loop1
```

3)
```
Loopx : DO i = 1, 10
        ........
        Loopy : DO j = 1, 10
                ..........
        END DO Loopx
END DO Loopy
```

4)
```
IF ( volts > 125. ) THEN
        WRITE (*,*) ' Warning: High voltage on line . '
IF ( volts < 105. ) THEN
        WRITE (*,*) ' Warning: Low voltage on line . '
Else
        WRITE (*,*) ' Line voltage is within tolerances. '
END IF
```

6c) Determine the value of ires at the end of each loop. **[10 marks]**

1)
```
ires = 0
DO index = 1, 10
        Ires = ires + 1
END DO
```

2)
```
ires = 0
DO index = 1, 10
    Ires = ires + index
END DO
```

3)
```
ires = 0
DO index = 1, 10
    IF ( ires == 10 ) CYCLE
    Ires = ires + index
END DO
```

4)
```
ires = 0
DO index1 = 1, 10
    DO index2 = 1, 10
        ires = ires + 1
    END DO
END DO
```

5)
```
ires = 0
DO index1 = 1, 10
    DO index2 = 1, 10
        IF (index2 > 6 ) EXIT
        ires = ires + 1
    END DO
END DO
```

UNIVERSITI MALAYSIA SARAWAK

94300 KOTA SAMARAHAN
SARAWAK

FAKULTI KEJURUTERAAN
(Faculty of Engineering)

Pengurusan Kejuruteraan
(Engineering Management)

KNF 4073

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	12 October 2004
Semester	:	2 Sesi 2003/2004	**Masa** *(Time)*	:	9.00 a.m – 12.00 p.m
Tempat *(Place)*	:	BS 11	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Ng Liang Yew			

Arahan *(Instruction)* :

1. **Jawab semua soalan.**
   (Answer all questions.)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

Question 1

a. Identify and define each of the management functions that you have studied.

[10 marks]

b. Describe the inter-relationship between each of the management functions that you have mentioned in part (a).

[15 marks]

Question 2

Clearly describe what do you understand by the following terms:

i. Scientific Management. **[8 marks]**

ii. Strategic Management. **[8 marks]**

iii. Management by Objectives. **[9 marks]**

Question 3

When Mustafa Kamal purchased his home, he borrowed RM80000 at 9% nominal interest compounded monthly. The loan has a 20-year term, and started on January 1, 2004.

i. What is the amount of the scheduled monthly payment? What is the total amount of interest paid over the 20 years?

[8 marks]

ii. If Mustafa pays an extra 10% of the scheduled amount each month, what is the total number of payments until the loan is repaid? What is the total amount of interest paid in this case?

[8 marks]

iii. If Mustafa has been paying an extra RM1000 with the December payment every year, what was the amount he owed at the end of the tenth year?

[9 marks]

Question 4

John Saggin is an engineer employ by PGH Construction company and works closely with Surely Munis who is also an engineer but employ by LN Supplies. LN supplies sells construction materials and supplies. Part of John's responsibilities are to negotiate and approve bids by LN Supplies that are submitted by Surely. LMN Supplies offers, and John accepts, an employment position with LN Supplies. John submits his resignation and gives two weeks notice to PGH Construction Company and is not asked and does not mention that he will be employed by LN Supplies. For the next two weeks before leaving PGH Construction Company, John continues to negotiate and approve bids submitted by LN Supplies. Explain whether it is ethical for John Saggin not to mention to PGH Construction Company that he will be employed by its vendor LN Supplies.

[25 marks]

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94300 KOTA SAMARAHAN
SARAWAK

FAKULTI KEJURUTERAAN
(Faculty of Engineering)

Pemprograman Kejuruteraan
(Engineering Programming)

KNF 1082

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	12 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	2.00 pm – 5.00 pm
Tempat *(Place)*	:	Dewan Kuliah I	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	En. Abdullah Hj. Yassin			

Arahan *(Instruction)* :

1. **Jawab Bahagian I, II dan III dalam kertas soalan ini manakala untuk Bahagian IV, sila jawab dalam kertas jawapan yang berasingan.**
   (For Section I, II and III, write down your answer in this question sheet while for Section IV, write your answer in the separate answer sheet given)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)
6. **Sila kembalikan kertas soalan ini berserta dengan kertas jawapan bagi Bahagian IV.**
   (Please return this question sheet together with answer sheet for Section IV)

INSTRUCTION: ANSWER ALL QUESTIONS [TOTAL MARKS: 100]

SECTION I (True or False):[23 marks] . Each question carries 1 mark.

1. In general, C++ statements are case sensitive.

   Answer: _____

2. The name of the primary function of a C++ program must be **Main.**

   Answer: _____

3. The statement *cout<<endl,endl,endl<<;* will create 3 blank lines.

   Answer: _____

4. C++ allows us to write nested comments.

   Answer: _____

5. The following *int* type variable names are legal:
   1cat, 2dogs, 3pears Answer: _____

6. We can print more than one variable value with a single *cout* statement.

   Answer: _____

7. The following C++ statement is legal
   2004=happy_new_year;

   Answer: _____

8. We need the *ofstream.h* header to write output to an external file.

   Answer: _____

9. The following C++ statement is executable

   if (today = = 7); else cout <<"Go to work";

   Answer: _____

10. Given x=200 and y=-400, determine whether each of these logical expressions is true or false.

    a. (x<y && x!=y) Answer: _____

    b. !(x>y) Answer: _____

    c. x = = 200 || x>200 || !x Answer: _____

11. A *switch* statement must contain a *default* section.

    Answer: _____

12. In a *for* loop expressions, the starting counter value must be smaller than the ending counter value.

Answer: _____

13. In C++, *day=+5* is similar to *day=day + 5*.

Answer: _____

14. A programmer-defined function may be written before the *main* function.

Answer: _____

15. One reason for defining a function is to avoid writing the same group of C++ statement over and over again.

Answer: _____

16. Only a function with a *void* return type is allowed to have an argument.

Answer: _____

17. A *struct* creates a new data type.

Answer: _____

18. All elements of a given array may be displayed by simply indicating the array name.

Answer: _____

19. We can use & on the left side of an assignment statement.

Answer: _____

20. Based on the declarations:
int a[3] [1] = {1, 2, 3}, b[3], c[3] [2], d[2] [3];

Determine whether the following statement is true or false:
Array c[3] [2] contains six elements : c[1] [0], c[1] [1], c[1] [2], c[0] [0], c[0] [1] and c[0] [2].

Answer:_____

21. Based on
int a[3] = {1, 2, 3}, b[3] = {4, 5, 6}, c[3]= {1, 2};

Determine whether the following statement is true or false:
c[0] = a[1] +b[2];
is incorrect because 0, 1 and 2 are different subscript numbers.

Answer:_____

SECTION II: [28 marks]

In this section, examine the C++ statement carefully and write whether they are valid or invalid. If valid, write the word "VALID" and explain the expected output. However if invalid, write the word "INVALID" and state why it is invalid and correct it. Each question carries 4 marks

1. Assume *a* is *int* and *a*=1,
   a. while (a<5) { cout <<"a=" << a ; a-- ; }

Answer: _____

_____

_____

_____

   b. Do (cout << "a=" << a; a++) while (a<5):

Answer: _____

_____

_____

_____

2. for (day=1, day<3, day ++)

Answer: _____

_____

_____

_____

3. float a23b[99]; 1xy[66];

Answer: _____

_____

_____

_____

4. int a = {11,22}; b[33];

Answer: _____

_____

_____

5. if (a>b)

```
{
        if (c>d)
        {
                cout<<"Find any error";
                other statement.....
        };
};
else
        {
                cout << "Can you find any error..";
        };
```

Answer: _____

_____

_____

_____

_____

_____

_____

_____

6. Find the syntax error in the following **struct** definition:

```
struct gas ;

{
    public
            temp,
            pressure,
}
```

Answer:

SECTION III: EXPLAIN AND WRITE THE EXPECTED OUTPUT FOR THE FOLLOWING C++ STATEMENT BELOW EXCEPT FOR QUESTION 3, JUST WRITE THE EXPECTED OUTPUT ONLY. [34 marks]

QUESTION 1: **[10 marks]**

```
# include <iostream.h>
  void function1 (int a, double x);
int main ( )
{
    int a = 1, b = 2, c =3, d = 4;
    double r = 3.2, s = 4.3, t = 4.5, u = 6.5;
function1 (a,b);
function1 (r,s);

}

void function1 (int a, double x)
{
    cout<< "a= "<<a<<", x= "<<x<<endl;
}
```

Answer:

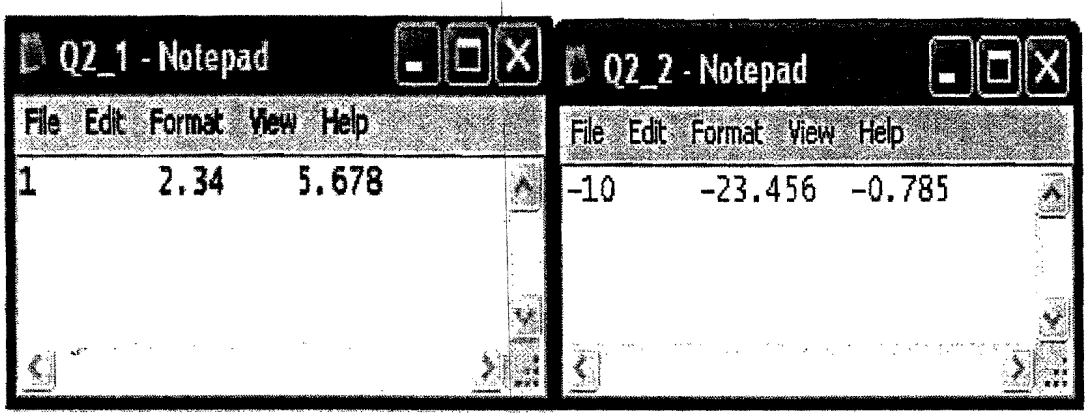
QUESTION 2: **[12 marks]**

```
#include <iostream.h>
#include <fstream.h>

int main ( )
{
    double x;
    int i, j;
    ifstream infile1("C:\\Q2_1.DAT");
    ifstream infile2("C:\\Q2_2.DAT");

    infile1>>i;
    infile1>>j>>x;
    infile1.close();
    cout<<"From first file i="<<i<<", j="<<j<<", x="<<x<<endl;


    infile2>>i;
    infile2>>j>>x;
    infile2.close();
    cout<<"From second file i="<<i<<", j="<<j<<", x="<<x<<endl;
}
```



Answer:

QUESTION 3: **[12 marks]**

```
#include <math.h>
#include <iostream.h>


int greatest_divisor(int a, int b);

int main( )
{
        int aa=56, bb=168, cc=16, divisor;
        divisor=greatest_divisor(aa,bb);
        greatest_divisor(divisor,cc);
}

int greatest_divisor(int a, int b)
{
        int remainder, input_a=a, input_b=b;

        while(1)
                {
                remainder = a % b;
                if (remainder = =0) break;
                else
                        {
                        a=b;
                        b=remainder;
                        }
                }
        cout<<"The greatest common diviser of "<< input_a <<" and "
                        << input_b <<" is "<<b<<endl;

        return(b);
}
```

Answer:

SECTION IV: WRITING A PROGRAM [write your answer in the separate answer sheet given].

QUESTION 1: **[15 marks]**

Write a computer program capable of solving the quadratic equation: $ax^2+bx+c=0$. The input data is to consist of the values of a,b and c and is to come from the keyboard. The output is to consist of the values of x and go to the screen. (Your program should be able to solve a real & imaginary part).

UNIVERSITI MALAYSIA SARAWAK

94300 KOTA SAMARAHAN
SARAWAK

FAKULTI KEJURUTERAAN

(Faculty of Engineering)

Kaedah Numerikal dan Statistik

(Numerical Methods and Statistics)

KNF 2053

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	15 October 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	2:30 – 5:30 p.m.
Tempat *(Place)*	:	BS 23	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Ng Liang Yew / Rohana Sapawi			

Arahan *(Instruction)* :

1. **Sila jawab bahagian A dan B dalam buku jawapan yang berasingan.**
   (Answer all questions for section A and B on separate answer books.)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

SECTION A:

Question 1

A solid of revolution is formed by rotating about the x-axis, the area between the x-axis, the lines x = 0 and x = 1 and a curve through the points with the following co-ordinates. Estimate the volume of the solid formed using Simpson's rule.

x	0.00	0.25	0.50	0.75	1.00
y	1.000	0.9896	0.9589	0.9089	0.8415

[10 marks]

Question 2

Use the Runge-Kutta method (order four) with step size 0.1 to find an approximation of $y(2.1)$, where $y(t)$ is the solution to the following initial-value problem:

$$y' = (t-1)^2 - y, \quad y(2) = 3, \quad 2 \le t \le 2.1$$

(Use at least 6 digits after the decimal point.)

[10 marks]

Question 3

Consider the following system of linear equations:

$$\begin{aligned} 12x + 200y + 20z &= 400 \\ 3x + 4y + z &= 4 \\ 800x + 600y + 30z &= 100 \end{aligned}$$

With rounding-off after third significant digit (round off all intermediate results), solve the system using Gaussian elimination with the scale column pivoting.

[10 marks]

SECTION B:

Question 4

The deflection temperature under load for different types of plastic pipe is being investigated. Two random samples of pipe specimens are tested, and the deflection temperatures observed are reported here (in °F):

Type 1		
206	193	192
188	207	210
205	185	194
187	189	178
194	213	205

Type 2		
177	176	198
197	185	188
206	200	189
201	197	203
180	192	192

i) Construct box plot for two samples. Do these plots provide support of the assumptions of equal variance? Write a practical interpretation for these plots?

[6 marks]

ii) Do the data support the claim that the deflection temperature under load for type 1 pipe exceeds that of type 2? In reaching your conclusions use $\alpha = 0.05$.

[8 marks]

iii) Calculate a P-value for the test in part (ii)

[6 marks]

Question 5

A post-mix beverage machine is adjusted to release a certain amount of syrup into a chamber where it is mixed with carbonated water. A random sample of 25 beverage was found to have a mean syrup content $\bar{x} = 1.098$ fluid ounces and a standard deviation of s = 0.016 fluid ounce

i) Do the data presented in this question support the claim that the mean amount of syrup dispensed is not 1.0 fluid ounces? Test this claim using $\alpha = 0.05$.

[10 marks]

ii) Do the data support the claim that the mean amount of syrup dispensed exceeds 1.0 fluid ounces? Test this claim using $\alpha = 0.05$. Find a 95% confidence interval on the mean amount of syrup dispensed.

[10 marks]

UNIVERSITI MALAYSIA SARAWAK

94300 KOTA SAMARAHAN
SARAWAK

FAKULTI KEJURUTERAAN
(Faculty of Engineering)

Matematik Kejuruteraan 1
(Engineering Mathematics 1)

KNF 1013

Peperiksaan *(Examination)*	:	Akhir	**Tarikh** *(Date)*	:	11 Oktober 2004
Semester	:	1 Sesi 2004/2005	**Masa** *(Time)*	:	9.00 am – 12.00 pm
Tempat *(Place)*	:	DK 1	**Jangkamasa** *(Duration)*	:	3 jam
Pensyarah *(Lecturer)*	:	Dr. Mohd Shahril Osman			

Arahan *(Instruction)* :

1. **Jawab semua soalan di Bahagian A. Pilih 4 soalan di Bahagian B**
   (Answer all questions in Section A. Choose 4 questions in Section B)
2. **Baca soalan dengan teliti sebelum menjawab.**
   (Read the questions carefully before answering)
3. **Tulis jawapan hanya di dalam buku jawapan yang disediakan menggunakan pen sahaja.**
   (Write the answers only in the answer books provided using only pen)
4. **Dilarang bercakap atau mengganggu calon-calon lain di dalam jangkamasa peperiksaan.**
   (No talking or disturbing other candidates during the duration of test)
5. **Calon tidak dibenarkan meninggalkan bilik peperiksaan dalam masa 30 minit pertama dan 15 minit terakhir.**
   (Candidates are not allowed to leave during the first 30 minutes and the last 15 minutes)

Section A

Answer all questions

Question 1

a) Express in partial fraction $g(x) = \dfrac{5-x}{(1+x^2)(1-x)}$ **[4 marks]**

b) Find the constants A and B in the identity:

$$\frac{x+7}{(2x-1)(x+2)} = \frac{A}{2x-1} + \frac{B}{x+2}$$ **[2 marks]**

Question 2

a) Sketch the curve of $y = \dfrac{1}{x}$. Find the equation of the normal to the curve at the point where x = 2. **[5 marks]**

Find the coordinates of the point where this normal cuts the curve again.

[6 marks]

b) Sketch the curve $y = 2x^3 + x^2 - 4x + 1$. Find the turning points and determine whether the points is maximum or minimum. **[7 marks]**

Question 3

Express in the form a + jb for

a) (4-*j*7)(2+*j*3) **[1 marks]**

b) $\dfrac{4+j3}{2-j}$ **[1 marks]**

Question 4

Evaluate

a) $\int_1^4 \frac{1}{(x+3)^2}dx$ **[2 marks]**

b) $\int_0^1 x^2\sqrt{x^3+1}dx$ **[2 marks]**

Question 5

Prove that:

a) $(1-\cos A)(1+\sec A) = \sin A \tan A$ **[4 marks]**

b) $(\text{cosec } A - \sin A)(\sec A - \cos A) = \frac{1}{\tan A + \cot A}$ **[4 marks]**

Question 6

a) Obtain the inverse function of $y = \frac{1}{5}(4x-3)$. **[4 marks]**

b) Sketch the gra ph of $f^{-1}(x)$ when $f(x) = x^2$. **[4 marks]**

Question 7

a) Express in polar form z = –4 + j2. **[2 marks]**

b) Simplify 3(cos 143° + j sin 126°) x 4(cos 57° + j sin 57°). **[2 marks]**

Question 8

Calculate the radius of curvature of the function $y = \cos x$ when $x = \frac{\pi}{4}$.

The radius of curvature is given as: $R = \frac{\{1+(\frac{dy}{dx})^2\}^{3/2}}{\frac{d^2y}{dx^2}}$ **[3 marks]**

Question 9

Find the volume generated when the plane figure bounded by $y = 5 \cos 2x$, the x-axis, and ordinates at $x = 0$ and $x = \frac{\pi}{4}$, rotates about the x-axis through a complete revolution.

[5 marks]

Question 10

Given a series having a geometric progression of $4 + 6 + 9 + 27\frac{1}{2} + \ldots\ldots$

Find S_{10}. **[2 marks]**

- End of Section A -

Section B

Answer 4 questions only

Question 1

Express $\left(1-\left(\frac{x}{2}\right)^2\right)^{\frac{1}{2}}$ and $\left(1+x^3\right)^{-\frac{1}{2}}$ as a polynomial expansion.

Hence evaluate $\int_0^{0.4}\left(1-\left(\frac{x}{2}\right)^2\right)^{\frac{1}{2}}\left(1+x^3\right)^{-\frac{1}{2}}dx$

[10 marks]

Question 2

Find the two roots using Newton-Raphson method for x^4+5x^2-7x+1.

[10 marks]

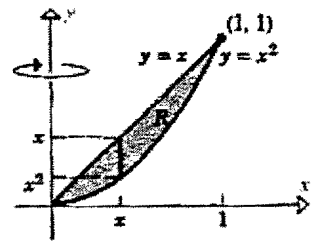
Question 3

A wire having a current I has a relationship with voltage and resistance of $I=\frac{V}{R}$. If $V=$ 250V and R = 50 ohms, find the change in I resulting from an increase of 1 volt in V and an increase of 0.5 ohm in R.

[10 marks]

Question 4

Use cylindrical shells to find the volume of the solid generated when the region R in the first quadrant enclosed between y = x and y = x^2 is revolved about y – axis.



[10 marks]

Question 5

Find the area generated when the curve $x = a(\theta - \sin\theta)$, $y = a(1 - \cos\theta)$ between $\theta = 0$ and $\theta = \pi$, rotates about the x-axis through a complete revolution.

[10 marks]

End of Section B

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Question 1

Determine the sum of the following series.

a. $\sum_{k=1}^{6} 9k$

b. $\sum_{k=1}^{4} (4k^2 + 5)$

c. $\sum_{k=1}^{5} 8k^2$

[3 marks]

Question 2

Determine the Maclaurin series for the following function

a. $y = \cos 2x$

b. $y = x^2 + \sin x$

[4 marks]

Question 3

Use the binomial theorem to expand

a. $(5x+y)^4$

b. $(2-3x)^4$

[4 marks]

Question 4

Used partial fractions to simplify the following expression

a. $\dfrac{2x-9}{(x-2)^2(x-3)}$

b. $\dfrac{3x}{(x^2-2x+5)(x+1)}$

c. $\dfrac{8(x+1)}{x(x^2-4)}$

d. $\dfrac{x^2}{(x^2+1)^2}$

[7 marks]

Question 5

a. If $x^2y+xy^2=3x$, Find $\dfrac{dy}{dx}$

b. If $y=\left[(x^2+1)^{1/3}+2\right]^{1/2}$, Find $\dfrac{dy}{dx}$

[6 marks]

Question 6

Determine the indefinite integral

a. $\int xe^x dx$

b. $\int e^{\sin x}\cos x dx$

c. $\int(4x^3+2x+1)(x^4+x^2+x)^3 dx$

[6 marks]

Question 7

a. Represent on an Argand diagram the complex numbers

(i) $3 + j2$

(ii) $-5 + j3$

(iii) $8 - j5$

(iv) $-2-j3$

b. If $z_1 = 3 + j2$ and $z_2 = 5+j3$, determine $\frac{z_1}{z_2}$

c. Find the real and imaginary parts of the complex number

$$z + \frac{1}{z} \text{ for } z = \frac{2+j}{1-j}$$

[8 marks]

Question 8

A contractor agrees to sink a well 40 metres deep at a cost of RM(Ringgit Malaysia) 30.00 for the first metre, RM 35.00 for the second metre and increasing by RM 5 for each subsequent metre.

a. What is the total cost of sinking the well

b. What is the cost of drilling the last metre?

[6 marks]

Question 9

The deflection at the center of a particular loaded beam is proportional to WL^3/d^4. What is the percentage increase in the deflection if W is increased by 3%, L increased by 2% and d decreased by 4%.

[6 marks]